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CONTENTS.

EDITORIALS: PAGE.
The Calumet & Hecla *against* the Quincy — Judge Lawrence's Decision ... 17
Mr. H. M. Howe's Table ... 17
The Anthracite Coal Trade in 1884 ... 17

New Publications ... 19
The Welsh Copper Smelting Process.—III ... 20
The Regenerative Gas-Furnace ... 21
The Endless Rope Haulage System at the Clifton Colliery, Nottinghamshire, England ... 22
Dividends Paid from American Mines during the Year 1884 and Total to Date ... 24
Notes on Coal-Dust in Colliery Explosions ... 24
Furnace, Mill, and Factory ... 26
Labor and Wages ... 26
Railroad News ... 27

NOTES:
Errata ... 23
A Tunnel under the East River ... 23
To Increase Power in Locomotives ... 24
Exports of Oil ... 25

COAL TRADE NOTES:
Canada ... 27
Colorado ... 27
Maryland ... 27
Missouri ... 27
New York ... 27
Pennsylvania ... 27
Rhode Island ... 27

COAL TRADE NOTES: PAGE.
Tennessee ... 27
West Virginia ... 27

GENERAL MINING NEWS:
Arizona ... 27
California ... 27
Canada ... 27
Colorado ... 27
Dakota ... 28
Idaho ... 28
Illinois ... 28
Michigan ... 28
Montana ... 28
Nevada ... 28
New York ... 29
Utah ... 29
Wisconsin ... 29

FINANCIAL:
Gold and Silver Stocks ... 29
Boston Copper and Silver Stocks ... 29
BULLION MARKET ... 30
METALS ... 30
IRON MARKET REVIEW ... 30

COAL TRADE REVIEW:
New York ... 31
Philadelphia ... 31
Buffalo ... 32
Boston ... 32
Statistics of Coal Production ... 32
Advertisers' Index ... xii

JUDGE LAWRENCE has decided as follows in the case of the Calumet & Hecla Mining Company *against* the Quincy Mining Company, in which the defendant was arraigned for having sold copper abroad contrary to an existing agreement: "I think that the contract referred to in the morning papers is void, as being in restraint of trade, and as against public policy. Even if I am wrong in this conclusion, this does not appear to be a case in which a preliminary injunction should be granted. If the defendant has violated its contract, the plaintiffs can maintain an action for damages resulting from such violation, and the papers now before me do not show that that remedy would be so inadequate and insufficient as to justify the granting of an injunction *pendente lite*."

This decision does not augur favorably for the success of any attempt to prevent the Quincy Company from following the independent course that it looks upon as more profitable. The small companies that are still members of the pool may deem it good policy to continue to act in harmony with the Calumet & Hecla; but they may develop an inquisitorial spirit, and may insist on knowing how much of their copper has been sold, for months to come, and under what conditions. At any rate, the spell is broken.

WE regret sincerely that our criticism of Mr. H. M. HOWE'S table accompanying his paper, in Mr. BURCHARD'S report on the production of the precious metals, has been apparently misunderstood. We did not sufficiently emphasize, although we did clearly state, that it was the *form* of the table against which we felt called upon to protest vigorously. That protest we can not and do not withdraw. For a private note-book that is intended as the daily companion of an engineer, the form that Mr. HOWE has chosen is undoubtedly serviceable; but our editorial experience has taught us that such space-saving devices, while appropriate for the individual who originates them, are improper and impracticable in print. If the condensation of information in tabular form is worth printing, it is worth all the space it needs to make it intelligible and to render reference to it a simple and easy matter. Mr. HOWE has sinned against this plain rule, and we question whether we are far out of the way when we say that in its present form his table is so discouragingly difficult to interpret that it is practically useless.

It is only just to Mr. HOWE, however, to state that, in spite of all care, we did make an error in our translation. Our attention has been called to the following: "Fe and Zn δ Ag μ, 00 HCl." This we made, "Iron and zinc do not dissolve its silver when solid, the reaction occurs only in hydrochloric acid." It should have been, "Iron and zinc cause the formation of metallic silver when molten, the reaction occurs only in the presence of hydrochloric acid." In another case, as we suspected, the government printer did the mischief. He had it, "Cu and Pb $\delta \lambda$ Ag ζ." We carefully translated it, "Copper and lead form or cause the formation of silver when molten—that is, in igneous fusion, silver partially." Now, it should have been, "Cu and Pb δ Ag λ ζ." Literally, this is, "Copper and lead forms or causes the formation of silver when molten, that is, in igneous fusion, partially." It seems, also, that, when one of the Greek letters is given two meanings in the vocabulary, both of them need not be applied, and that, furthermore, a translator of fair average intelligence should not render the symbols literally, but give a free translation, under which arrangement the last group of symbols would be rendered about thus: "Metallic lead and copper reduce molten argentous sulphide (to which, we may explain, these particular reactions refer) to metallic silver, but only incompletely." This is certainly very satisfactory—when you get there; and we repeat, Mr. HOWE'S table is unquestionably very valuable, provided that it is not, as we suspect, full of typographical errors. We must be excused, on the plea of pressing duties, from acquiring any certainty on that subject by translating the table first literally, then liberally. But we must also reiterate that the form of the table makes it well-nigh useless, and that we fail to see the necessity for any table at all, when the same amount of information in plain English sentences would have taken less than double the space, and would be as handy for reference. Our intentions, marred, unfortunately, by errors in translation of our own, and by the mistakes of the government printer, were kindly, and Mr. HOWE, we believe, owes us a debt of gratitude should we have succeeded in arresting him in a course for which he has already displayed an unfortunate fondness in his paper on a new nomenclature of minerals, read before the Troy Meeting of the American Institute of Mining Engineers.

THE ANTHRACITE COAL TRADE IN 1884.

The anthracite coal trade has, during the year 1884, suffered severely from causes that, though complex, may be classified in two groups those growing out of the general business situation, and those that may be referred to features inherent in the development of the anthracite mining industry and in the financial position of some of the leading interests. The former are too widely and too generally known to need discussion. They have undoubtedly led to a direct shrinkage in the demand, or rather to an effacement of the usual rate of increase in the demand, which the anthracite producers have learned to look forward to. The great bulk of the quantity of anthracite coal consumed is, of course, taken for domestic uses, the volume fluctuating chiefly with the severity of the winter season. Taken over reasonably long periods, this demand shows a steady growth in old quarters, and pretty regularly expands in consequence of the widening of the area made tributary to anthracite by its introduction into new fields. Except in the West, where anthracite is a luxury to some extent, and where it comes into competition, as a high-priced fuel, with very cheap local bituminous coals, the domestic market can not be contested, whatever prices may be. It is quite a different matter with the sizes for manufacturing and steam purposes. Bituminous coal is a better steam fuel, even at the same cost, and the steady progress of engineering will surely remove the only objection against it—the smoke. The tendency

frequently alluded to in these columns during the past few years is toward making anthracite more and more the domestic fuel of the more thickly inhabited parts of our country ; and for this purpose it is so exceptionally well adapted, over all known fuels in the world, that it has little rivalry to fear. Steam heating by the central distributing system, or the use of water-gas as a fuel, has as yet made so little headway as to give no ground for alarm. On the other hand, the evident drift of affairs is toward the gradual exclusion of hard coal as a manufacturing fuel. The deposits of bituminous coal available to tide-water and interior points are very extensive. The soft coal is more easily and more cheaply mined, and the railroads by which it is carried are less heavily loaded financially, so that the coal is delivered at considerably lower figures.

The principal factor, however, which has been a constant menace to the anthracite coal trade, has been the enormous growth of the productive capacity, fostered directly by the particular method by which the restrictive policy was carried out. By appointing days of idleness, the companies were left fully at liberty to mine as much as they chose during periods of work. All of them opened additional colleries in rapid succession, and made all the necessary arrangements to have a heavy tonnage. The result has been, that the number of idle days has steadily increased. In 1881, only 43 days of suspension were ordered ; in 1882, 49 ; in 1883, 60 ; and in 1884, over 100. To a certain extent, these figures do not even closely reflect the movement alluded to, because the three days per week stoppage plan was soon found to virtually amount to less than it implied, because the idle days were utilized to get every thing ready for a rush as soon as work could be again begun. During the year just closed, therefore, full weeks' stoppages have been insisted upon since early summer. One of the highest authorities in the coal trade, as the result of an exhaustive, detailed study, has stated that the daily productive capacity of the anthracite colleries has increased from about 100,000 tons in 1881 to nearly 126,000 tons in 1884, taking into account all the causes that contribute to affect it ; for instance, the severity of the weather in winter, and the heavy influx of water in spring. That is to say, the anthracite collieries can all the year around produce 756,000 tons weekly, or fully 39,000,000 tons annually. During the period of this growth of capacity, consumption had shown an increase equal only to one half of that amount, and this fact, coupled with the falling off in the demand, at last brought about the revolt against the system of restriction that has led to the final adoption of the allotment plan.

The refusal of the Pennsylvania Railroad to join in the combination is not, as has been urged, necessarily fatal to the maintenance of the new policy. That company has for years acted independently, and while it probably will steadily increase its shipments, the latter have not as yet assumed such dimensions as to defeat the objects of the plan. We have repeatedly dwelt upon the advantages of the latter during the past year, and the stoppage of a large number of collieries by the different companies will be a direct and large saving to them. It will, it is true, work hardship to many miners ; but, on the other hand, will afford more regular and constant employment to those of the working force retained. Whether the future will develop serious defects in the new system, and of what nature they will be, if developed, remains to be seen. It is certain, however, that the trade is now on a comparatively sound basis, unhampered by the constant agitation and bickerings that have become, unfortunately, one of its leading features of late.

January.—The announcement, early in the month, of the decision on the part of the companies to work only three days in a week, had the effect of slightly stimulating inquiry. The very large quantity of coal afloat, however, checked any possible tendency to a better inquiry. There was no marked weakness, however. In the middle of the month, the Pennsylvania Coal Company advanced its prices, which, however, was without any immediate effect, a good deal of buying having been done in anticipation of it. The holding for higher figures had the result of causing purchasers to hold aloof, and the month closed very quietly. Quotations, which were $4.10@$4.15 f. o. b. for stove coal in the beginning of the month, were $4.25@$4.30 at the end.

February.—The month opened very quiet and dull, with a marked tendency in buyers' favor. It was characterized chiefly by the rapid growth of a strong agitation in favor of bituminous coal for steam sizes, notably throughout New England. The change of a number of large mills there, in closing their yearly contracts, from anthracite to bituminous coal, was at first lightly passed over by anthracite producers ; but it gained in strength and was not without its serious effect upon the market. The latter steadily declined under a constant pressure to sell and an unchanged front on the part of buyers, so that the entire advance of the previous month, largely nominal as it was, was lost.

March.—Late in February and early in March, the usual agitation as to the opening prices unsettled the trade, and purchases were quite generally withheld in anticipation of some concession on the part of producers that would recognize the changed conditions affecting the future of the trade and the general decline in values of raw and manufactured goods. It was urged in behalf of the trade that lower prices would stimulate buying, and so aid the movement of coal, which at frequent intervals clogged every thing. The companies decided otherwise, and the figures named by them proved a decided disappointment. Their action undoubtedly had much to do in creating the difficulties against which they struggled later in the year, floundering about in a distressing manner. The prices were promptly undercut, and were really nominal only, the month closing with stove coal, f. o. b., ranging at $3.90@$4.

April.—The trade dragged along during the first two weeks, because the companies could apparently come to no conclusion concerning their future programme, and a feeling spread among buyers that, even should half-time be agreed upon, lower figures might be expected on account of the very heavy production, which even the strongest measures possibly to be agreed upon could not in reality cope with. Toward the middle of the month, the companies, frightened evidently by the continued necessity for stocking coal under full-time work, consented to a week's stoppage as a measure of immediate relief, and somewhat later agreed to continue the restriction in May, taking out one full and one half-week. They agreed, too, that in the future a majority vote, on the basis of the production, should be decisive in settling future arrangements as to time and method of stoppages. The confidence of the companies in the effect of this action, and their tendency to hold out for full figures, turned over what little business there was to individual operators, who steadily undercut their greater rivals, who found stocks accumulating on their hands.

May.—The market was very dull, and it became more and more evident that the remedy adopted for the overproduction was not strong enough. Persistent efforts were made by some of the companies to induce the others to consent to a change in the announced stoppage of three days at the close of the month to a full week ; but the pleas of the financial necessities on behalf of some of them were too forcible to resist, and the idea was abandoned. Meanwhile stocks were accumulating, and the market sagged. Of late years, it has been a difficult matter, under any circumstances, to get buyers to anticipate future wants, because the great extension of the railroad and other transportation facilities make it possible for them to provide themselves with the needed supplies at any time. This feeling was strengthened in 1884 by the constant expectation on the part of consumers and of many dealers that a rupture might any time occur. It would be idle to deny that the procrastination and the hesitation on the part of the companies to take prompt decisive measures lent a good deal of color to this hope. During the month, the price of stove coal ranged between $3.85 and $4 f. o. b. In June, a suspension of two full weeks was announced.

June.—This month passed away quietly, and at one time a considerably firmer feeling prevailed. In the middle of the month, the coal companies announced two weeks' stoppage for July, but unfortunately coupled it with a meaningless advance of 25 cents on stove coal and 15 cents on egg coal. The measure was an unwise one, and was evidently taken in order to frighten buyers. It appeared, too, that large amounts of coal had been previously contracted for, so that the attempt to force up prices lost much of its strength.

July.—The month opened with a very dull market, to the low condition of which the rumors concerning the strained relations between the coal companies contributed a good deal. There is no doubt that there was a good deal of friction, and the situation more than once looked critical. In the more conservative councils of the trade, the conviction prevailed that it would be absolutely necessary, to secure a good business during the active season, to continue the policy of restriction during August. Different plans for the future guidance of the coal trade began to be eagerly discussed, since it was quite generally conceded that the prevailing system was a dangerous and unsatisfactory one. The favorite plan was that of proportioning the quantity of coal required by the market by allotment. Unfortunately, an adverse decision was reached concerning a restriction in August, and full-time was agreed upon, not without some struggles, which lent color to the agitation concerning the future policy of the combination.

August.—Buyers, fully appreciating the fact that the productive capacity was enormously in excess of current requirements, and that a full month's work could not help telling on values, maintained an attitude of indifference. It appeared that the persistence of at least one company in demanding full work was due to a claim that it had not, under half-time work, had an opportunity to ship its fair proportion of coal Westward. In spite of this Western outlet, to which much prominence was given, coal began almost immediately to accumulate at tide-water points, and increase in so rapid a manner that it soon partially worked its own cure, by the inability to unload cars and return them to the mines, where their scarcity began to impede shipments. The situation was growing worse at an alarming pace, and it was decided to stop work during the first week in September. The month developed much weakness, and it was pretty thoroughly understood before it had closed that the full work of August had destroyed all hope of an opportunity to advance prices during the coming season.

September.—The stoppage of the first week brought with it no improvement. It simply checked a tendency that, if allowed to progress farther, would have soon ended in chaos. Urgent efforts were made to induce the companies to agree to another week's stoppage during the month, but in vain. The market was toward the end more animated, a condition of affairs due, however, chiefly to the open concessions generally made by all on the basis of $3.75 for stove coal.

October.—The beginning of October witnessed another stoppage of an entire week ; and as the month advanced, there was a greater activity in domestic sizes. Some of the companies having been heavy sellers, were in pretty good shape ; others, having been less persistent in making concessions, were still pretty well loaded with coal. A decision reached early in the month, that there would be a full week's stoppage in November and two weeks in December, had the effect of brightening the outlook, notably for domestic sizes, for which there was a good demand at better figures, from $3.90@$4 being the ruling quotations for stove coal. On the other hand, manufacturing sizes continued to drag heavily.

November.—The month was characterized by periods of activity in domestic sizes, and the movement of coal was on the whole a very fair one. There was some agitation toward the end of the month, looking to a change in the announced times of stoppage in December, the improvement having evidently caused the managers of the coal companies to forget partially the severe lessons of previous months.

December.—The month was one of constant ferment over the future of the coal combination, and at more than one time the continuance of even the semblance of harmony among the companies seemed imperiled. The action of the Lehigh Valley Company in bidding as low as $3.04 for the contract for the elevated railroads, however, had the effect of putting an end to recriminations, and led up to the full discussion of the allotment plan, which has now been adopted.

The general outlook for the coming year is one of comparatively low prices, notably in manufacturing sizes. There can be no doubt that the coming struggle for ascendency between the sellers of anthracite and bituminous coal for steam purposes will be a very sharp one. The slight indications that are beginning to gather of an improvement in the demand for manufactures will not, we believe, even if the most sanguine hopes are realized, very sensibly affect the situation, since the many quarters from which bituminous coal now reaches tide-water will make any such movements appear comparatively insignificant.

The following is a summary of the anthracite coal tonnage for each month, according to the figures gathered by Mr. John H. Jones, official

accountant, for the years 1883 and 1884. We have added the figures submitted in a preliminary way as proposed for the current year:

	1883.	1884.	1885.
January	2,075,741	1,899,572	1,500,000
February	1,937,996	1,892,687	1,500,003
March	2,375,512	1,981,463	1,800,000
April	2,511,710	2,828,210	2,400,000
May	2,439,224	2,628,142	2,400,000
June	2,690,581	2,029,179	2,500,000
July	2,615,686	2,602,615	2,800,000
August	3,324,711	3,552,410	3,250,000
September	3,084,355	2,677,890	3,250,000
October	3,426,273	3,063,434	3,250,000
November	3,198,094	3,031,954	3,250,000
December	2,133,248	2,130,000 (est.)	2,100,000
Total	31,793,028	30,217,557	30,000,000

The different companies participated in the total of the first eleven months, as follows:

COMPANIES.	Eleven months 1884.	Eleven months 1883.	Difference.
Philadelphia & Reading Railroad	10,282,172	11,477,484	D. 1,195,312
Lehigh Valley Railroad	5,429,984	5,849,307	D. 419,324
Delaware, Lackawanna & Western RR.	4,727,986	4,708,419	I. 19,567
Delaware & Hudson Canal Company	3,067,506	3,288,977	D. 221,471
Pennsylvania Railroad	2,927,172	2,557,625	I. 369,547
Pennsylvania Coal Company	1,266,927	1,432,170	D. 165,243
New York, Lake Erie & Western Railroad.	385,810	345,904	I. 19,905
Total	28,087,557	29,659,886	D. 1,572,329

Allowing about 6 per cent for colliery and local consumption, the output of the anthracite collieries was fully 32,000,000 tons in 1884, against 33,700,000 tons in 1883—a decrease of 1,700,000 tons approximately.

NEW PUBLICATIONS.

THE UNDERGROUND HAULAGE OF COAL BY WIRE ROPES. A Practical Essay, written for John A. Roebling's Sons' Co., of Trenton, N. J. By WILBUR HILDENBRAND, C.E. Copyrighted 1884. Trenton, N. J.: John A. Roebling's Sons' Co. Pages 66. Profusely illustrated.

Only a week or two since, when speaking of the many gaps in American mining literature, we mentioned among others that of underground haulage. We were not at that time advised of the publication, for private circulation among the patrons of the well-known firm of wire rope makers, Messrs. John A. Roebling's Sons' Company, of Trenton, New Jersey, of a pamphlet that fills that gap in the most admirable manner. Mr. Hildenbrand, who has compiled it evidently after a close personal study of the different systems as applied at our mines, notably on the Monongahela River and in Ohio, groups the many methods into five classes—the self-acting or gravity inclined plane, the simple engine plane, the tail rope system, the endless system, and the cable tramway. The latter, we may add, though not strictly a method for underground haulage, has been, fortunately, included in the pamphlet, though it was not at the outstart a part of the plan. Aside from the description and thorough illustration of the general methods and appliances, selected from standard American and English practice, we note with particular pleasure special references to general arrangement and to details at many different mines. We may refer, among others, to the plate showing the braking apparatus for the gravity plane at the Imperial mines, the underground engine plane at the Standard mine, with locks and safety-switch, the engine planes at Brown's mine on the Youghiogheny, at the Coal Valley mine, and at the mine of the Stewart Iron Company, where the coal is hauled from five side entries. Among the examples of the tail rope system illustrated and described, we find one by the Birmingham Coal Company, one by the Mansfield Coal and Coke Company, two at the works of Gray & Bell, one at the Louis Staib Colliery, Monongahela, one at the mine of Homer & Roberts, one at the Smithson mine on the Youghiogheny, one at the mine of Hardley & Marshall, and one at the Lovedale works on the Monongahela. All of these plants exhibit modifications of the tail rope system at American collieries, to which Mr. Hildenbrand adds a description of the leading details of such English plants as the the well-known North Hatton Colliery. The endless tail rope system is represented by the plant at the State Line mine, East Palestine, Ohio, at the Imperial mine in Pennsylvania, with an illustration of the grip-car or "dilly" patented by the Imperial Coal Company and at the Buck Mountain anthracite colliery, to which are added descriptions of the system at the Eston, Bridge, and other collieries in England.

This closes the chapters on underground haulage proper. It is followed by a description of the system adopted successfully at some of the coke-works of feeding coke-ovens, by moving the larries by wire rope, the particular example chosen for illustration being that of the Stewart Iron Company. Mr. Hildenbrand suggests another method, by providing each track with two ropes running in opposite directions between the rails.

Then follows a pretty thorough discussion of the two main systems of surface wire tramways, with stationary and movable rope, and of some of the many different appliances brought forward for automatic dumping. A discussion of surface inclined planes and general notes on the qualities and the proper uses of wire ropes close the pamphlet, which is illustrated by 32 full-page plates in all, and by many drawings and sketches in the text. Mr. Hildenbrand and the Roeblings are to be congratulated on the manner in which the large mass of material has been grouped and arranged, and we feel convinced that the little work will be prized by mining engineers and colliery owners as a valuable addition to their libraries.

DER BASICHE BESSEMER- ODER THOMAS-PROCESS. (The Basic Bessemer or Thomas Process.) By Dr. HERMANN WEDDING, Berlin. First Supplement to the Treatise by the same Author on the Manufacture of Weld Iron. 8vo, 206 pages, with many Illustrations. Braunschweig: F. Vieweg und Sohn.

During the first and second years immediately following the announcement of the invention of the basic process, technical literature was flooded with special contributions on the subject, and the technical and commercial questions affecting the basic process were discussed with unparalleled eagerness. Then followed a calm, which is apparently the natural outgrowth of the settlement of the most important points and the beginning of an era of development of details. Dr. Wedding's work will, therefore, be particularly welcome to metallurgists, because it closely reflects not only the achievements of the earlier days, but also gives specific data on what has been accomplished in the quiet period alluded to. Dr. Wedding has an introductory chapter on the earlier processes for the elimination of phosphorus, among which the Bell and Krupp processes were at the time the most prominent. He then quotes Mr. Thomas's patents, and goes into a discussion of the merits of different basic materials. Among them, the only one worthy of notice is magnesia. At one time, the manufacture of magnesia, by the Closson and the Scheibler process, was experimented with; but both have been since abandoned, and practically to-day dolomite is the only material used for lining basic converters. It was soon found that dolomite must be burnt at a very high temperature, and the addition of tar became necessary to give it the needed plasticity. At Alexandrowsky, Russia, 17 to 18; at Hoerde, 10 to 12½; at Creusot, 10 to 11; at Middlesborough, 9 to 10; at Kladno. 9; at the Rhenish Steel-Works, 8 to 9; and at Rothe Erde, 7 per cent of tar is used.

Dr. Wedding furnishes interesting details on the form of the converters used; but it may be said in a general way that these special contrivances have not been successful in practice. As for the size of the basic converters, the large quantity of cinder made in the process makes their capacity smaller, the ratio being about 6½ or 7 to 10. When the lining is made of basic brick, laid in mortar, it will last from 45 to 55 blows; when it is built with tar-brick, from 60 to 90; and when it is rammed up with the tar and burnt dolomite mixture, it will stand from 80 to 130 blows—a decided improvement over the achievements in 1881. Dr. Wedding quotes also, though only briefly, Wasum's interesting experiments concerning the life of basic materials under the action of air—a matter which, in the early days, seriously threatened the future of the process. The trouble experienced at first with the gathering of accretions at the throat of the converter has not been quite overcome by the special forms of converter adopted to meet it. It has been found, however, that, by carefully lining the throat with a mixture containing a larger proportion of tar, and particularly by using pig higher in manganese, the difficulty is practically insignificant. The bottoms have been a source of considerable trouble. Dr. Wedding describes and illustrates the different methods, and furnishes the following details concerning their wear. Their average life is now 18 blows, the figures fluctuating between 15 and 20, which is the record at Creusot, while Rothe Erde reports from 18 to 20. Continual repairs are necessary, however, to reach these higher averages. At Teplitz, acid bottoms last 30 or 40 blows, under constant repairs, however.

Dr. Wedding's fourth chapter treats of the materials used. Taking up pig-iron first, he states that the best pig is that produced at Ilseda, Germany, containing approximately 3 per cent of phosphorus, above 2 per cent of manganese, 0·5 per cent of silicon, and under 0·1 per cent of sulphur. We reproduce the following table of analyses of iron used at different basic works:

	Phosphorus.	Manganese.	Silicon.	Sulphur.
Peine, best quality	3·0	2·2	0·5	0·08
" limits	1·5 to 3	2·0 to 2·5	0·5 to 0·7	0·08 to 0·45
Luxembourg-Lorraine, average quality	2·0	1·5	0·75	·05
Luxembourg-Lorraine, limits	1·2 to 2·5	1·0 to 1·5	0·1 to 0·8	0·13 to 0·6
Metz & Co	1·86	0·63	1·19	0·05
Rodange	1·75	0·61	1·32	0·08
Hoerde	1·5 to 2·5	2·2 to 3	0·40	0·10
" (Luxembourg)	2·18	1·03	1·22	0·08
"	1·22	not deter.	0·43	not deter.
"	1·28	0·52	0·66	0·29
"	not deter.	3·19	0·16	0·02
"	2·60	2·37	0·30	0·05
"	1·99	2·80	0·20	0·05
Ruhrort	2·09	not deter.	1·34	not deter.
"	1·40	0·41	0·56	0·41
Rothe Erde	1·75 to 2·0	1·50	0·80	not deter.
Angleur	1·50 to 2·0	1·0 to 1·5	1·0 to 1·25	0·25
Ougrée	1·39	1·0	1·25	0·10
Creusot	2·5 to 3·0	1·5 to 2·0	1·30	0·20
Oberhausen	not deter.	2·00	1·00	not deter.
Neunkirchen	not deter.	2·00	0·50	not deter.
Wittkowitz, usual grade	2·47	1·18	0·42	0·13
"	1·95	1·00	0·54	0·23
"	3·46	1·16	0·11	0·09
"	2·00	1·38	0·62	0·08
" bad results	0·90	not deter.	0·79	not deter.
Kladno	1·50	0·3 to 0·5	1·2 to 1·3	1·05
Middlesborough	1·50	0·70	1·7	0·05
"	1·75	0·30	1·3	0·15
"	2·75	1·00	1·0	0·12
Limits, pig actually used, according to Thomas	0 75 to 3·0	0·35 to 2·0	0·5 to 1·3	0·1 to 0·2

Dr. Wedding gives the following specification for pig for the basic process: Phosphorus, maximum, 3 per cent, average from 2 to 2·5 per cent; minimum, 1·5 per cent; silicon, harmless below 0·5 per cent; maximum, 2 per cent; manganese, most favorable, from 2·2 to 3 per cent; average, 2 per cent; minimum, 1 per cent; carbon, usually 3 per cent; sulphur, maximum, 0·1 per cent; if more, from 1 to 1·5 per cent of manganese needed to counteract 1 to 1·5 per cent sulphur, generally present 0·08 per cent, sometimes only 0·05 present, or less.

Concerning the addition of spiegel, Dr. Wedding says that the tendency to higher grades is stronger even in the basic than in the acid process. The quantity of lime used as a basic flux varies considerably, ranging between 10 and 18 per cent. It is generally used in as hot a state as possible, and must not be burnt too much, so that it is still porous. The blast has generally a high pressure, the Heft works having blowing-engines capable of producing 4½ atmospheres. Heating the blast has been abandoned, because it has a bad effect. Göransson, on the contrary, proposes to coal it.

Dr. Wedding, in his fifth chapter, describes the manipulations proper. He states that a blow takes less time in the basic converter than it does in the acid process, varying between 13 and 25 minutes. The average is 18 minutes, which he accounts for as follows: 13 minutes for the blow proper, and 5 minutes for the after-blow. Counting for the charging of additions 5 minutes, for the running into the converter of the pig 5 minutes, for the addition of spiegel 5 minutes, and for casting 7 minutes, he reaches a total of 40 minutes; so that without bottom repairs, 38 blows could be made in twenty-four hours. The latter, however, takes so much time that the number of blows rarely exceeds 30, is generally only from 20 to 24, and is often only from 14 to 15. Putting in a new bottom gen-

erally takes 45 minutes. The waste, of course, varies within wide limits, according to the character of raw material. It fluctuates between 11 and 19 per cent, 14 being the average, though from 17 to 18 is a very frequent figure. Dr. Wedding describes the ladles, cranes, and general arrangements for handling product, and refers to the Gjers soaking-pit, without, however, stating that it is in actual use at any one of the basic works. Dr. Wedding's next chapter is on the chemical and physical reactions, on which, however, there is little that is new. Numerous analyses and diagrams of metal in different stages of the process, and of slags, are appended, with elaborate heat calculations based chiefly on Ehrenwerth's works. Then follows a chapter on the general arrangement of basic Bessemer works, including illustrations of Holley's plan, of the Erimus, Wittkowitz, and Peine plants. A special chapter is devoted to dephosphorizing in the reverberatory, and then follows one of the most valuable chapters of the work, on the economic success of the basic process. Dr. Wedding says that the manufacture of steel is still dearer by the basic than by the acid process, the principal item of expense being the repairs to the basic lining. He seems to hold, and there is every reason to believe that he is right, that the Thomas process is particularly suitable for the manufacture of ingot iron, or those grades of steel that are lower in carbon and are known as soft steel. This, indeed, would open for it a brilliant future.

THE WELSH COPPER SMELTING PROCESS.—III.*

By A. M. Levy, Namur.

Smelting for Blister Copper.—The furnace used is the same, though its construction must be more careful and the binding of stays must be more solid, on account of the larger charge that it is to hold. When the bottom is a new one, smelting for white metal is carried on for at least a week. If an attempt be made to make blister copper on a new bottom without using this precaution, there is danger of losing a good deal of copper by its absorption by the sand of the bottom, which renders the starting very difficult. There is a further risk. The metal may, on account of its great density, get under the bottom, which is still soft and adheres very little to the brick-work of the furnace. In this case, the entire bottom rises, and there is nothing else left to be done but to take it out in pieces, and make a new hearth.

The charge of the furnace is so calculated that the quantity finally tapped is four tons. The white metal is cast in pretty thin cakes, so that it can be easily introduced into the furnace, and an effort must be made to so pile up these cakes of matte that the draught of the furnace is pretty completely intercepted. The fire is then less strong, and the charge melts as slowly as desired, thanks to the reflected heat. Skillful men succeed in making the top of the pile touch the roof. The operation lasts twenty-four hours, and consists in alternately fusing and cooling the metal.

A start is made, as in the preceding operations, by melting the material drop by drop under the action of a current of air, keeping the temperature as low as possible. The entire charge spreads over the hearth of the furnace, and as the air introduced through the side door has considerably chilled the furnace, the matte chills in part. The oxidation is allowed to continue for a while, and then the side door is partially closed, in order to melt the charge.

At this juncture, the latter is a mixture of sulphide, oxide, and reduced metallic copper, the iron being almost entirely scorified. During the fusion, the sulphide and oxide of copper react upon one another. Sulphurous acid escapes, and a part of the copper separates. When the fusion is complete, the side door is again opened and calcining is resumed.

After from ten to twelve hours' work, during which the alternate calcining and melting have been repeated more or less frequently, according to the grade of the white metal, the side door is completely closed, and the charge is carried to complete fusion. Then the slag is removed through the front door, the work being done in the manner described in smelting for white metal. The quantity of slag is small, because the white metal contained little iron, and no additions of slag were made to the charge. It is not very fusible, and floats in the bath in patches. When all the slag has been removed, the working-door is luted.

The melted material in the furnace consists of two layers. On the bottom, is the copper that has been separated in the metallic state, and above it is a thinner or thicker layer of sulphide of copper, which is very fluid at the high temperature to which the furnace has been brought.

The side door is half-opened and the charge is stirred from time to time, the temperature of the furnace being so regulated that the material does not begin to chill, although, on the other hand, it must not be overheated. The temperature is judged by the aspect of the material near the door. The cold current of air causes pasty agglomeration of the materials near the door; but if the furnace is too cold, these masses increase, and the door is gradually closed to melt them. In passing the rabble over the surface of the bath from time to time, the workman finds out the thickness of the layer of sulphides. When the latter becomes so thin that the rabble uncovers the metallic copper, the fire is freshened up a little. Soon the calcining, which went on over the whole surface of the bath, ceases near the side door, which is noted by the absence of movement in that vicinity. The escape of sulphurous acid is so active during the calcining that the material appears to be boiling.

When the material is in quiet fusion, near the door the charge is well rabbled to present new surfaces. About an hour after this time, the whole mass is quiet and the slightly cooled bath covers over with a coating of oxide and loses its brightness. This is the sign that the operation is completed. It is well, however, to rabble once more, in order to introduce into the bath a certain quantity of suboxide. When the fire is then pushed, in order to have the charge liquid enough for casting, the suboxide reacts upon any sulphide which might still be present dissolved in the copper, and it is thus eliminated. The side door is carefully luted, and the charge is run up to a high temperature, at which it is kept for about half an hour. Then the charge is cast into deep sand molds. The cakes of copper weigh about 400 pounds, and they are made pretty large, in order to avoid as much as possible oxidation during the fusion that precedes the refining.

* *Revue Universelle des Mines*, Vol. 26, No. 2, p. 286.

Blister copper of good quality flows quietly in the sand molds. It has a very decided green color, and must be very liquid. It must not rise during cooling, which would indicate that there is still present unreduced sulphide. When this is the case, it happens often that after the surface of the pigs has cooled, the copper that is still liquid in the center breaks through the crust and rises. The metal should not be allowed to retain enough sulphur to produce this phenomenon. It is well, therefore, to take the precaution alluded to, and to rabble the mass in the presence of a current of air when the calcining has apparently ceased. As soon as the copper has set, the pigs must be detached from one another. It is easy to separate them when the copper is still red-hot. When the copper has been allowed to cool too much, it becomes hard work, and it may become necessary even to resort to the chisel.

Blister copper cast in pigs has a brick-red color, with a darker surface. The latter is uneven, and the metal is full of blow-holes, especially its upper part, which is covered with blisters, from which it derives its name. The fracture of the metal varies a good deal. Sometimes it is granular, sometimes fibrous, depending a good deal on the quality of the ores, and particularly on the manner in which the blister smelting has been carried through. When the copper has not been perfectly cleaned of sulphur, small round cavities are formed in it, the surface of which has a very brilliant gold-yellow color. These cavities are always observed in ingots of copper that have risen during cooling.

The percentage of copper varies from 98 to 99 in favorable cases. During the smelting for blister copper, very little arsenic or antimony is eliminated. In fact, analyses that I have made bearing on this subject have given very slightly lower figures for the blister copper than those found for the white metal used in making it. This confirms what has been said on this subject in treating of the white metal.

We have now reached the metallic copper; but before describing the refining that is to remove the last traces of impurities, it will be useful to give an idea of the importance of every operation, as compared with the others, so far as it relates to the number of furnaces. A works having ten ore furnaces, four red-metal furnaces, four blue-metal furnaces, four white-metal furnaces, and two blister furnaces, can, with one refining-furnace, produce weekly from 40 to 50 tons of ingots or bars, provided rich ore can be obtained as an addition during the second and third operations.

Refining.—The refining of copper is a delicate operation, over-refined copper being as poor in quality as metal the purification of which is not yet complete. The correct point is difficult to strike, and the slightest divergence in one direction or in the other yields an inferior metal, especially for rolling purposes. Before passing to the description of the process proper, we will briefly give the principles upon which is based the elimination of the small quantities of foreign substances that blister copper always contains. As we have already noted, blister copper may contain as high as 99 per cent of pure copper. As a general rule, the grade varies between that limit and 96 per cent in more unfavorable cases. The impurities consist of iron, nickel, arsenic, antimony, and sometimes tin. These metals and metalloids accompanying the copper yield much less stable oxides than the oxide of copper. When they are once produced, nothing need be feared but that reducing agencies, which are a necessity in the operation, return them to the metallic state, and thus permit them to alloy with the copper once more. On the other hand, the foreign metals are easily scorified in presence of suboxide of copper at the temperature at which the operation is carried out. The latter yields its oxygen to them, and is thus reduced to the metallic state. When, therefore, molten copper is exposed to the action of air, suboxide of copper is produced, which is dissolved in the metal. Thus, the vehicle of the oxygen is brought into intimate contact with the foreign substances, and the latter are scorified. But evidently the formation of an excess of suboxide of copper must be submitted to, in order to reach a complete scorification of the impurities. Arsenic, however, resists this action, and it is necessary, in order to eliminate it, to use another means, which will be described later on. On the other hand, copper, when it contains a certain quantity of suboxide, loses its malleability completely and becomes unfit for industrial purposes. It is well known that oxide of copper is very easily reduced. Carbonic oxide, solid carbon, and the hydrocarbons resulting from the distillation of wood are the different reducing agents that are used to deoxidize the metal. Copper has one peculiarity: When the action of the reducing agents upon the molten metal is prolonged, the suboxide disappears gradually, and the copper becomes more and more malleable. The malleability soon reaches a maximum, and the fracture of the cooled metal then has the characteristic rose color and silky fiber. From this moment on, if the carbon continues to act, the fracture shows a yellowish tinge. The malleability disappears completely, and the copper becomes brittle. The fracture is coarse, semi-crystalline, and seems covered with a transparent varnish. We shall refer again to this peculiar state of the metal, which is then over-refined.

The refining-furnace is smaller than the others. The heater is 12 feet long by 8 feet wide at the widest part. There are two doors. The grate is 4 feet square, and is four feet below the top of the fire-bridge. All the walls of the furnace are covered by cast-iron plates held by rails and rods, which is necessary on account of the heavy charge. The lower part of the bottom of the hearth is made of sand, well saturated previously with cinder from the white metal smelting. As the putting in of the upper layer of the bottom is a very difficult operation, some details may be given. The greatest care must be taken in choosing the sand, which must be absolutely free from any particles of lime or clay. It must be as pure silica as possible. The sand is spread over the lower part of the bottom, which has been sufficiently cooled, and it is first allowed to dry in a moderate heat, carried gradually to dark-red. It is thus calcined, in order to remove any organic matter. It is spread evenly over the bottom with a rabble, and partly brought up against the fire-bridge and the side walls of the furnace. The hearth must have a pretty pronounced dip toward the front, and must be so arranged that all the metal flows toward the working-door when casting. In front of the working-door, a basin is cut into the sand from 8 to 10 inches deep, from which the metal is ladled during casting. It has a diameter, on top, of 18 inches, and on the bottom, of 10 inches. This basin is made with the back of a well-heated ladle, and with a little practice no difficulty is experienced in keeping the sand from running. In that case, I have mixed a little

Dinas clay with the sand near the door, and the result has been, that the basin has remained intact during pretty long service. A well-made bottom must not possess any local depressions. When the sand has been well distributed and the basin finished, a small inclined plane is fixed toward the side door, which facilitates the work of introducing the cakes of blister copper. The fire is pushed, all the openings being closed, and the furnace is carried up to the highest possible heat, which is kept up for five or six hours. The hearth is examined, to note whether it is well agglutinated and has a firm surface. It will be remarked, as a rule, that the edges of the bottom have separated a little from the masonry, as the result of the contraction of the sand.

Copper scrap and blister copper are charged until the quantity amounts to nearly a ton and a half. The whole is rapidly melted. If the dip of the bottom toward the front is not too strong, the melted metal will cover the greater part of it. With the aid of the rabble, the melted copper is thrown against all the parts of the hearth and sides, so as to make it penetrate into all cracks. This is done every half-hour, in order to make the hearth absorb the greatest possible quantity of the metal. At the end of four or five hours, the rest is ladled out, the temperature is lowered, and the side door partly opened, to partially oxidize the metal that has remained in the pores of the hearth. Thus a little silicate of copper is formed, which renders the bottom more impervious. It should not be expected, however, that the absorption of metal by the hearth will be completely avoided for all the succeeding charges. In any case, it is sure that, if the operation has been well carried through, the chances of the rising of the upper layer of the hearth will be much diminished. That is the great danger. It frequently happens that a newly made bottom rises the first time it is used, the copper having worked in under it. When that happens, there is a considerable loss of copper, not counting the difficulties met with in taking out the parts of the defective bottom. It is necessary to ladle out as much copper as possible, break up the bottom, take out the fragments, and start over again. It will be readily understood that it is not possible to recover all of the metal of the charge. A part of it has been absorbed by the lower layer of the bottom. Besides this, it is necessary to melt over again all the sand that composed the wrecked hearth, and thus undergo inevitable losses in the cinder, not counting the heavy cost of treatment, since the material is extremely refractory.

The first charges made on a new bottom must be comparatively light. The first charge particularly is very difficult to carry through well, because of the considerable quantity of silica with which the metal comes into contact. After some operations, the bottom is covered with silicate of copper, and the refining becomes much easier work. Besides this, since a new bottom is very porous, the absorption will be all the greater the heavier the charge is. This is evident, and the cause is, that the bottom carries a greater pressure. Including the copper used for the first saturation, to which we have alluded above, the bottom will absorb from 2·5 to 3 tons of metal in the first charges. The maximum charge to start with is 6 tons, increased by one ton for every consecutive charge until the full charge is reached, which is ten tons for the dimensions given.

THE REGENERATIVE GAS-FURNACE.

On a New Method of Heating the Regenerative Gas-Furnace.*

By Mr. Frederick Siemens.

In every description of furnace that has hitherto been designed, either for heating or melting, it has always been considered that the first condition of successful working was to make the space to be heated as small as circumstances would allow, so that the flame might be brought into as intimate contact as possible with the inside lining of the furnace, and more especially with the material under treatnent. This method of constructing and working furnaces, which was a necessary condition of success in all cases in which it was proposed to obtain a high temperature with the use of solid fuel. was also adopted in regenerative gas-furnaces, which until quite recently were heated on the same principle. The author, however, has for some time doubted the correctness of this view, and from experience gained in the practical working of this class of furnace, after long and careful trials, has satisfied himself that they should be arranged so that the flame should only radiate heat upon the material to be heated or melted, and not come into actual contact with it, as has hitherto been the case. Further practice on the same lines has led to the development of the mode of heating to which he wishes to draw the attention of the Iron and Steel Institute on the present occasion. The gas and air-ports, instead of being so arranged that the flame shall impinge upon the materials placed on the bed of the furnace, as hitherto, open at some distance below the roof of the melting-chamber, and at some distance also from its side walls, so that the gas and air, after ignition, have unobstructed space for entering into combustion and for the free development of the flame, which is kept as much as possible from contact with the roof, walls, or materials on the furnace-bed ; and when these are crucibles, ingots, blooms, or packets of iron, they should be placed sufficiently far apart to allow the radiant heat to have free access all around them. Where there are working-doors, the flame should pass above their level ; in this way, the men will not be inconvenienced while watching operations inside the furnace ; but, as already mentioned, the main object to be secured is to avoid contact of the flame with the materials under treatment, or with the walls of the furnace.

In constructing furnaces according to this new method of heating, the air inlet may be arranged above the gas inlet, thus forming two parallel horizontal ports for the delivery of the gas and air in broad streams into the furnace-chamber, the inflowing air overlapping the gas at each side ; the gas and air may be brought into the furnace-chamber in several streams side by side, the air-ports, which are more numerous than the gas-ports, being also placed at a higher level than the latter ; or, again, as used in connection with a crucible steel-melting furnace, as the length of travel of the flame is comparatively short, the gas is brought into the chamber by two ports, having an air-port between them, and additional air-ports on each side, the ignition commencing as soon as the air and gas, which are delivered in thin streams, reach the hight at which the flame is to travel across the furnace from end to end. This arrangement is one that could be applied in other cases, where, on account of the shortness of the melting-chamber, the air and gas have to be well mixed on ignition, to secure complete combustion before their exit at the other end of the furnace. In cases in which there is a great length of travel for the flame, the ignition is retarded by means of a horizontal wall or tongue, so that it shall only take place at the entrance of the gas and air into the furnace-chamber, and the combustion may be extended throughout the furnace, the flame in this case taking a semicircular or horseshoe course.

The furnace as now built appears at first sight to be unnecessarily high and wide ; but this new method of heating high temperature furnaces by radiation requires a large space for the development of the flame and for securing the advantages which may be obtained by its use. In order to realize the circumstances under which these benefits are obtained, it must be borne in mind that in the regenerative gas-furnace the amount of fuel used does not depend so much upon the intensity as upon the quantity of heat required ; whereas in the old furnaces, in which direct combustion of solid fuel takes place, intensity can only be obtained by means of a strong chimney draught or a blast, and the consumption of very large quantities of the best fuel ; and even with their use, the highest temperatures required in the arts are difficult to get, and still more so to maintain, the difficulty and expense increasing with the size of the furnace.

Thus it has been ascertained that in an ordinary crucible steel-melting furnace heated by means of solid fuel, about two per cent only of the heat developed is taken up by the steel, so that nearly the whole of the great mass of coke used is expended in getting up and maintaining the furnace at steel-melting temperature. In a regenerative gas crucible steel-melting furnace, on the other hand, when once the steel-melting temperature has been reached, it is easily maintained with a moderate chimney draught, and therefore by the burning of a comparatively small quantity of fuel, which may be of a poor quality, so that the greater part of the heat of combustion is taken up by the steel, while what remains amply suffices to maintain the crucibles and furnace at the necessary temperature, and only a very small quantity escapes through the chimney.

The following is an actual comparison between an ordinary reheating furnace using solid fuel and one on the regenerative gas principle. The former uses about three tons of a fair quality of coal in a shift of ten hours, while a regenerative furnace of equal capacity takes about two tons for the same time, there being a saving of 33⅓ per cent. But if both furnaces are merely kept at a welding heat without any cold iron being charged, then the solid fuel furnace requires about 2½ tons of coal per ten hours, while the regenerative gas-furnace takes half a ton at the outside ; so that, when it is only necessary to maintain a certain temperature, the regenerative gas-furnace shows an economy of 80 per cent, while it is 33⅓ per cent when both furnaces are bringing iron up to the welding heat. The results here given are from the author's personal observation ; but in some cases the advantages gained by the use of the regenerative gas-furnace for heating purposes have been greater, reaching from 40 to 50 per cent.

It is evident, from the above considerations, that in regenerative gas-furnaces a flame of very high temperature is obtained, such as is required for working by radiation, while the greater part of the heat so produced is taken up by the material charged, and that therefore there is no reason why the heating-chambers of these furnaces should not be enlarged to any reasonable extent, and at the same time be built so that the flame does not come into contact either with the sides and roof or with the material to be heated. Not only does the regenerative gas-furnace lend itself to this mode of construction and of application of the flame, but experience proves that great economy in fuel is thus effected, to which must be added in many cases the indirect saving obtained by a considerably increased output and the improved quality of the material produced when it is not exposed to contact with the flame, while the furnaces themselves last much longer. There can be no doubt that the very remarkable results of improved quality and increased output of material, with a longer life of the furnace, can only be brought about when the active flame is not allowed to act upon the materials within the furnace, the interruption of the processes of combustion by the interposition of solid bodies always tending to injure or even to destroy them.

But besides the circumstance that solid bodies are injured by flame, it can be easily shown that, when flame is brought into contact with any solid body, it is more or less quenched, according to the substance, size, and temperature of the body. A very simple experiment in proof of this, and one that is familiar to most people, is the following : Take any ordinary illuminating gas flame, such, for instance, as a bat's-wing, and place a glass rod or tube in the middle of it ; the flame will immediately burn dull, and a large quantity of lamp-black will be deposited on the piece of glass. This action is most marked when the rod is cold, but takes place, though in a less degree, at any temperature, for the reason that the material to be heated is necessarily always at a lower temperature than the flame, also owing to the disturbance in the combustion caused by contact of the solid substance with the flame. The author hopes shortly to treat this subject more fully, from a physical point of view ; but the experiments he has made establish the following most important fact, namely, that a good flame, or in other words, perfect combustion, can only take place in an open space, or in one of sufficiently large size to allow the gases to burn out of contact with solid material.

To show more clearly the advantages that have been so far derived from the application of this new system, it will be well to give a few examples of comparative results in working regenerative gas-furnaces constructed on the old and new principle. A glass pot furnace built at Dresden ten years ago, and which has been reconstructed for experimental purposes, shows the economy of this method of heating most effectively. This furnace held ten pots, and melted glass every night that was worked out during the day, giving a daily production of about 3000 bottles in a shift of seven hours, or, after allowing for pot breakages, a monthly production of from 70,000 to 80,000 bottles. The pots lasted about three weeks, and the furnace itself about six months ; during this time, it required many repairs, which naturally interfered with its production. At present, the same furnace, supplied with the same quantity of fuel, and working the same charges, produces daily

*Paper read at the Chester Meeting of the Iron and Steel Institute.

5000 bottles in a shift of nine hours, amounting to a monthly production of from 130,000 to 140,000 bottles. Fewer pot breakages also occur, less repairs are required, and the amount of waste has decreased; moreover, the glass metal is obtained from a cheaper composition than hitherto used, and proves to be of a far superior quality. The pots last fully double the time, and melt more than three times the quantity of material, while the furnace itself stands for three years; that is, it lasts six times as long, and melts more than nine times the quantity of material it did previous to its reconstruction. As the flame is kept away from the working-holes, the glass-blower is able to work more at his ease and to turn out a better product, besides being able to heat his glass in the furnace without tarnishing it. There are also several other advantages of a minor character, which, with those already referred to, enable the glass-blower to supply over 50 per cent more goods without much greater exertion on his part

Another furnace, from which glass lamp-chimneys are made, gives still more favorable results. The mixture employed is much more refractory than before, and the glass produced is of a better quality and of a whiter color, while the glass-maker is now able to produce this superior kind of glass in open pots; that is, in the same manner as common glass is made. The result is, that the closed pots formerly used for melting the finer qualities of glass, in order not expose the batch of mixture to the direct influence of the flame, are no longer required, whereby a considerable saving in pots and in fuel is realized.

Similarly advantageous results are attained in the open-hearth steel melting-furnace. At the Landore Siemens Steel-Works, near Swansea, the furnaces that were altered at the end of last year and at the beginning of this to this new method of heating have already outlasted the furnaces reconstructed upon the old type at the same time, while they work more uniformly, giving an improved and larger output, owing to less oxidation of metal, as is proved by more ore being required per ton of pig-iron used in order to decarbonize it to the same extent. The life of these furnaces is expected to be five or six times as long as that of the old furnaces, while great economy in the consumption of fuel per ton of steel melted should be realized. This method of heating is now being adopted at several other steel-melting works in this country, and will be found particularly advantageous where steel is intended to be made from inferior qualities of pig-iron by the adoption of a basic lining.

Another important application of this method of heating is to forge, mill, and puddling-furnaces, as, owing to the absence of contact between the flame and the materials with which the furnace is charged, a great reduction in the loss of metal, which has hitherto occurred through oxidation, will be effected.

In steal reheating-furnaces, contact of the flame with the ingots produces red-shortness in the metal, exhibiting itself in fissures, particularly at the corners of the ingots or blooms, when these are subjected to treatment either under the hammers or in the rolls. The removal of the injured portion involves a stoppage of the operations, resulting in a waste not only of material but of time also, and occasionally rendering the blooms entirely useless for the purposes intended. In the radiation furnace, this cause of loss will no longer exist, while there will also be a saving due to non-oxidation of the metal.

In iron reheating-furnaces, the gain in metal will be much more considerable than in furnaces for the reheating of steel, owing to the higher temperature at which they are worked, and the metal will weld much more easily, as it is heated out of contact with flame. These furnaces should be made as long as convenient, in order to obtain as much room for the development of the flame as possible, and for placing the ingots, blooms, or packets sufficiently far apart to allow the radiant heat to reach them on all sides.

In applying this new method of heating to puddling, it might be advantageous to erect a furnace containing a number of pans, which could either be placed in two rows, the men working at each face of the furnace, or the men could work all on one face by constructing the furnace of a horseshoe form.

For many other applications of the new system, experiments have either been prepared or trials already made; for instance, for heating boilers by means of gas. When it is considered that the temperature of the water in a boiler working at 60 pounds pressure on the square inch is only 311 degrees Fahr., while the temperature of gaseous flame may be taken at 4000 degrees Fahr., it will readily be perceived what a quenching effect the metal of the boiler, which is of course at the temperature of the water, has upon the flame. In this case, the principle has been followed of letting the active flame consume itself in the open space of the tube without allowing it to touch the sides until after complete combustion has been effected, when the products of combustion may be brought into direct contact with solid bodies. By such an arrangement, complete and smokeless combustion is obtained, with the result of longer life to the boiler, the sides of which more readily deteriorate through direct contact with the flame than from any other cause. As the heat of the flame that is not transmitted by radiation comes, after complete combustion, into direct contact with the sides or flues of the boiler and its regenerators, it is completely utilized, and a saving of fuel to the extent of 25 per cent is secured by this method of heating.

The results obtained in actual practice show that there can be no doubt that almost all heating apparatus used in the arts, in which direct contact of flame with the substances treated is not necessary for chemical reasons, will be materially improved by the application to them of the principle of transmitting the heat of flame by radiation only, while the heat of the completely burnt products of combustion is better utilized by contact.

Complete combustion of fuel is insured by this method of heating, and it will therefore entirely abolish the smoke nuisance. Smoke is never formed when combustion is complete, being always caused by flame coming into contact with solid bodies, the process of combustion being thereby checked. This is, for instance, the reason why brick-kilns generally smoke so abominably; for in them scarcely developed flame is forced to impinge immediately on cold bricks, and can therefore only act in a very incomplete and uneconomical way. The author has frequently made the observation, with regard to regenerative furnaces, that a short combustion-chamber invariably gives very unsatisfactory results, and accounts for it by the fact that the flame is hardly formed before it has to pass through the outlet ports and into the checker-work of the regenerators, where its combustion is checked, and smoke is formed in consequence. To work well, a brick or pottery kiln should be so built that the flame can burn itself out in a free space before being brought into contact with the bricks or pottery. Zinc-distilling furnaces, and in fact all furnaces in which muffles, tubes, crucibles, and other vessels are used, will in the same way be much more economically worked on this new principle.

From these various descriptions of the regenerative gas-furnace, as now applied, it will be readily understood that the heat of the flame is utilized in two distinct conditions and periods, the one following the other. The radiation period, with its active combustion of the highest possible intensity, is limited to the furnace-chamber, which is made of ample dimensions, so as to allow the flame free space to develop without obstruction to its chemical action by intervening objects; while, after combustion is at an end and radiation ceases to be effective, the products of combustion, in passing through the loose brick-work of the regenerators, deposit their remaining heat by getting into close contact with the large surface of the bricks.

This system of utilizing the heat of flame in two successive stages is the most economical as regards the consumption of fuel, and ought to be the ideal aimed at in all heating operations.

In conclusion, I may add that, although the regenerative gas-furnace has been well known and appreciated on account of its economy and efficiency for many years past, it will, when the principle of the exclusive use of the radiant heat of the flame to the heating-chamber is applied in a thorough and efficient manner, give results that will far surpass any that have been obtained from it hitherto, and that its application in the arts will be multiplied to a degree which even its warmest admirers would scarcely have thought possible a short time ago.

THE ENDLESS ROPE HAULAGE SYSTEM AT THE CLIFTON COLLIERY, NOTTINGHAMSHIRE, ENGLAND.*

By H. Huxham.

The Clifton Colliery is situate close to the town of Nottingham, and consists of a pair of pits, sunk to the hard coal, and raising about 4600 tons of coal a week, working eight and a half hours a day. The colliery is laid out with air-compressing plant, Guibal fan, and all modern arrangements, and the winding-shaft is fitted with Fisher's patent automatic apparatus at top and bottom for loading and discharging the cages. There are two main roadways branching off from the pit bottom nearly at right angles to each other, one going in a northerly direction for a distance of some 1050 yards, with an average gradient against the load of 1 in 24, and having a branch roadway 850 yards long with an average gradient of 1 in 56 against the load. There are four junctions in these roadways, at which loaded trams are attached to the rope, and empties taken off. The other runs in a westerly direction for a distance of some 850 yards, with an average gradient against the load of 1 in 65, and having a branch roadway 1750 yards long, with an average gradient of 1 in 41 in favor of the load. There is also a branch to a self-acting endless rope incline, working at a gradient of 1 in 6; and also a junction where trams are put on and taken off. The rope roadways are all laid with a double line of tramroad, with 18-pound rails. The gauge is 2 feet, and the roads are laid so as to allow a clearance of 2 feet between the passing trams, and a clearance of 6 inches at each side, so that the width of the roadway is about 9 feet. Of course, the trams would work equally well with a clearance of 6 inches in passing, or in a roadway 7 feet 6 inches wide; but it was found that the air-current was obstructed too much with that width of roadway, besides which the clearance of 2 feet allows ample space for persons passing along the roadways with perfect safety, while the ropes are working. Each of these two main roadways, with their respective branches, are worked by a separate haulage engine and plant; the quantity conveyed from the north road being some 2000 tons a week, and from the west road about 2600 tons. The haulage plant on each of these roadways is fully capable of conveying to the pit from 1000 to 1200 tons in the ordinary working day of eight and a half hours, and at the present time is only, therefore, working up to a little more than one third of its full capacity.

The engine and driving gear on each of the roads are similar in every respect, and are placed near the pit bottom, so that the loaded trams, when detached from the rope, run by their own gravity to the pit bottom. The engines comprise a pair of 14-inch cylinders, by 2-foot stroke, geared three to one with spur gearings, and two to one with bevel gearing, so that the rope driving-wheel makes one revolution to six of the engine. For convenience of arrangement, the engine is placed in an arched chamber in the roof immediately above the roadway, while the vertical driving-shaft of the rope-wheel is sufficiently long to reach a recess built underneath the roadway, where the driving and tightening-wheels are placed. The engines are driven by compressed air, at about 60 pounds pressure to the square inch, supplied by a pair of air-compressing engines on the surface, with cylinders of 30 inches in diameter by 4-foot stroke. An air-receiver of 40 feet by 7 feet diameter is placed at the compressing engines, and one of 12 feet by 6 feet diameter at each of the hauling-engines. The hauling-engines are so arranged that they can be started or stopped by the attendant who detaches and puts on the trams at the pit end of the ropes, or by the on-setter at the pit bottom, so that no engine-man is needed. Besides this, the attendants have perfect control of the haulage ropes, by the screw hand-gear placed in the center of the roadway at the engine stations, by means of which the friction-clutch of the driving-wheel can be immediately thrown out of gear, and the ropes stopped or started again at pleasure, quite irrespective of the movement of the engine. Electric signals are laid throughout, with bells at the pit bottom, engine stations, and all the branches and junctions, which can be rung from any part of the roadway in the usual manner. The signals sound simultaneously at all the stations, and are well understood by the boys and attendants. The driving-wheel is of cast-iron, 7 feet in diameter, with flanges 4 inches apart, the boss being bored at the center to fit the driving-shaft, on which

* From a paper read before the South Wales Institute of Engineers.

it turns freely. A washer and collar, securely keyed to the shaft, keeps the wheel in position. Its periphery is turned true and lined with cast-steel segments 4 inches wide, having a taper in that width of $\frac{11}{16}$th of an inch, so as to produce an inclined or conical surface for the rope to coil upon, and on which it readily fleets (as the full rope coils on) in the same manner as a rope does on a capstan drum. A cast-iron friction disk-wheel 2 feet 6 inches in diameter, having a groove 5 inches wide, by three quarters of an inch in depth, truly turned in its circumference, is securely keyed on the shaft in such a position as to allow the driving-wheel to rotate freely. A cast-steel friction band, made in four segments, works in the turned groove of the friction-wheel, the ends of each of the four segments of the band being turned up square and recessed to contain brass screwed nuts, in each pair of which work strong right and left-hand screw-pins, by a slight turn of which the friction-band can be made to securely grip the friction-wheel, or release it altogether. The center of the back of each segment of the friction-band is made with a swell and bolt-hole, to receive strong steel stud-bolts, passing through and securely bolted to four of the arms of the driving-wheel, so that the friction-band, when released from the friction-wheel, remains stationary with the driving-wheel, but, when gripping the friction-wheel, causes the driving-wheel to revolve with it. The gripping or releasing movement of the friction-band is produced by means of a cast-steel sliding-box, moving horizontally on the shaft, and having four arms connected with short links to the lever ends attached to the four right and left-hand screws. Motion is given to the sliding-box in the usual manner by stud-pin levers, working in the slot of the sliding-box, and keyed on the rocking-shaft, to which motion is given by lever and screw-rod worked by hand wheel. A slight movement of the sliding box to the right or left hand is sufficient to cause the friction-band to grip or release the friction-wheel. To prevent wear and tear, or any jarring or grinding action, the friction-band and groove of the wheel are kept well oiled. This friction-clutch has been in use for several years, and has proved to be most efficient in every way, as it can be readily adjusted to any required strain on the rope, and works so smoothly that it is commonly thrown in and out of gear quite irrespective of the speed at which the engine may be working.

The ropes, which are made under Lang's patent, are of best plow steel, $2\frac{1}{2}$ inches in circumference, and weigh $7\frac{1}{2}$ pounds per fathom, and have wire strand centers instead of hemp, as it was found that ropes with hemp centers stretched and became reduced in thickness, and were not so well adapted for this system of haulage, with the use of the clip-hooks. The ropes are well spliced at the junctions, and the writer was informed that in no case had a splice given way. In the north roadway and branch, the rope is in one length of some 4000 yards. There are three coils of rope on the horizontal driving-wheel, the full rope coiling on at its larger diameter and larger portion, while the empty rope passes off at its smaller diameter and upper portion. The incoming rope is made to coil in the required position on the wheel by a guiding-sheave placed close up to the wheel; and in like manner the outgoing empty rope is slightly lifted off the coils on the wheel, by a carrying-sheave brought up close to the wheel on the opposite side. During this action, the coils of rope on the wheel are gradually "fleeted" up the conical surface of the wheel, from the larger to the smaller diameter, in an almost imperceptible manner, and without causing any appreciable frictional strain or wear on the rope. This action really constitutes the special feature of the driving arrangement, and is remarkably perfect and smooth in its action. From the driving-wheel, the empty rope is carried around the tightening-pulley, which is 7 feet in diameter, running in a wheeled frame, and balanced with a weight of about 15 cwt. Thence, the rope passes up at an inclination of 1 in 4 through wood boxing to the first carrying-sheave on the ingoing tramroad, where the empties are attached with clip-hooks as it travels along. Wherever there are bands or curves in the roadway's side, sheaves 8 inches in diameter are placed to keep the ropes in the center, and these are of such a form as will enable the clip-hooks attached to the ropes to readily pass without obstruction. All the rope sheaves and rollers are of crucible cast-steel. Following the course of the ropes in the northern roadway, after passing from the tightening-sheave, the rope is carried along the center of the right hand or empty tramroad around the curve of 5 chains radius, where it passes around a second 7-foot tightening-pulley, having a balance-weight of 15 cwt., and returns along the center of the full tramroad as the full rope, then around a 7-foot sheave placed under the roadway at the angle of the junction of the two roadways, whence it is carried along the center of the ingoing empty tramroad, where it passes around a 7-foot tail-sheave, and returns along the outgoing tramroad as the full rope.

There are two boys employed at the pit end, one to detach the loaded trams and attend to signals for stopping the rope in case of accident, and one to push the empty trams from the pit bottom and attach them to the ingoing rope. One boy is also employed at each of the inbye ends of the ropes, to put on the full trams and to take off the empties. Two boys are also employed at the junction of the two roads, to pass the full trams coming along over the junction, and the empty trams going into the roadway. Boys are also employed at the other junctions, to attach full trams, and take off the empties, working to and from the sidings. One man acts as road-man. The usual speed of the rope is $1\frac{1}{4}$ miles an hour, or 44 yards a minute, and this has been found a convenient and safe speed to enable the boys to attach the trams to the ropes by the clip-hooks, and take them off. At this speed, a boy can easily attach or take off six trams a minute with the clip-hook, and taking each tram to carry on an average 10 cwt. of coal, the rope would deliver 3 tons a minute; or, reckoning only 50 minutes in the hour, 1200 tons per day of eight hours.

The clip-hook is just long enough when hooked into the hitching-place of the tram and clasping the rope, to suspend it at a hight that will clear all the carrying-sheaves, and the rope is kept so taut that, when the trams are about 15 yards apart, the rope is carried clear of the ground; but rollers $7\frac{1}{2}$ inches long and $3\frac{1}{2}$ inches diameter are placed in the roadways where found necessary, so as to carry the ropes when the quantity of coal conveyed is not sufficient to require the trams being at such close intervals as 15 yards. The clip-hook is made by preference of Low-moor iron, so that when the tram gets off the road from a lump of coal falling off the trams, or any other obstacle being on the road, the bow part of the hook straightens out and prevents injury to the rope. The clip part of the hook is fitted with interchangeable bushes, so that when worn too large to grip the rope, they can be cheaply and easily replaced. The size of the hole in the bush is about $\frac{1}{16}$ larger than the rope, so that when the clip is held exactly at right angles to the rope, it slips easily through the bush, but as soon as the hook is inclined out of the perpendicular, it grips the rope. In putting on the hook, the boy first lifts up the loose collar and opens the hinged clip. He then quickly hooks the bow into the hitching-plate of the tram, and, allowing the hook to fall perpendicularly, passes the hinge under the rope so that the open half of the bush is brought up against its under side, and as soon as it is in this position, he lifts up and closes the hinged part, dropping the loose collar down over it. The whole action is extremely rapid, very simple, and most effective. In detaching the trams, the boy has only to lift up the loose collar, when the hinged part falls open, and he immediately unhooks the bow from the hitching-plate.

The trams are 4 feet 2 inches by 2 feet 11 inches over, and 1 foot 10 inches deep, with crucible steel wheels 12 inches diameter, the top of the tram standing 3 feet above top of rails. They weigh $4\frac{1}{2}$ cwt. empty, and will carry $11\frac{1}{2}$ cwt. of coal as usually loaded 2 feet above the top. At the junctions, the roadways are slightly raised, so that the ropes may pass below in grooves cut in the crossing rails. The method of working the ropes in the west roadway is slightly different. The rope works as already described. A 6-inch vertical shaft carried by suitable framing in bearings at the top and bottom is placed below the roadway. A 7-foot driving-wheel is securely keyed on to the center of the shaft, and the rope is carried three times around this wheel before it returns as the full rope. This gives motion to the shaft and allows power to be transmitted from it. On the same shaft, above and below the keyed center wheel, are placed driving-wheels and friction-clutch gear.

At the time of the writer's visit to the colliery, it would be almost impossible to imagine any haulage plant working more smoothly and regularly, and he was strongly impressed with the perfect manner in which every detail was working, and the excellent way in which the whole arrangement had been devised and carried out; and he was assured that, with the exception of a few stoppages now and then, occasioned by lumps of coal falling off the trams, the whole arrangement customarily worked day by day as regularly and smoothly as when he saw it. He very carefully examined the ropes in use, cleaning off the dirt in several places for that purpose, and he was perfectly satisfied with the statement that the rope on the north roadway, which, he was informed, had been at regular work for over four years, was very slightly worn, and would probably last another four or five years. The ropes on the west road, which had been on for nearly two years, looked almost like new ropes, and the wear was inappreciable. All the ropes were working in dry roadways, and were kept well oiled every three or four weeks. The indicated engine-power in working the two roadways with the ropes running at $1\frac{1}{2}$ miles an hour, trams attached every 22 yards, and delivering 120 trams, or 60 tons an hour, as taken by Mr. Fisher, is as follows, namely:

	Total horse-power of engines, ropes, and load.	Engines alone.	Ropes and load.
North	31·2	11·0	20·2
West	12·8	3·9	8·9

The system of endless rope haulage, described in this paper, appears to the writer to embody the following important economic principles:

1. Comparatively small engine-power required.
2. Slow speed of the ropes, and consequent reduction in all wear and tear, and risks of trams getting off the roads, and other haulage accidents.
3. Utilizing the counterbalancing action of the trams on undulating and inclined roadways.
4. Greatly prolonged "life" of the ropes over any other system. Saving of weight of rope over the endless chain, and of length of rope over the tail-rope system.
5. The perfect automatic action of the rope, the trams working readily around curves and up and down hill, having only to be attached at one end and taken off at the other end of any given length of roadway.
6. The weight of the rope being chiefly carried by the trams, and at all times working along the center of the roadway.
7. Favorable facilities for working branch roadways in any direction, and for transmitting power to a distance underground.
8. Entailing the employment of less labor than other systems.

With the exception of one, or possibly two, salient points, the writer is of opinion that there would be no difficulty in applying the system to the large trams of the South Wales coal-fields. The two points are:

1. The necessity for continuous double roadways to adopt the system in its entirety—although possibly some modified form by working the ingoing rope through one roadway, and the outgoing through another, might be adopted, where, as in South Wales, the roofs are too tender, as a rule, to admit economically of continuous double roadways.
2. The question how far a system that requires a much greater number of trams could be economically employed, when the larger tram is so much more costly than the smaller one.

ERRATA.—In our issue of January 3d, on page 4, line 12 below title, "Atlas of Anthracite Coal-Fields," *for* Montour, *read* Montana. And on page 7, line 12 from bottom of page, *for* Non-metallic copper, *read* Now, metallic copper.

A Tunnel under the East River.—It is stated on good authority that, after a long consultation with Mr. Rutter, the President of the Hudson River and Harlem Railroad system, an agreement has been arrived at whereby, upon the completion of a tunnel under the East River at Blackwell's Island, and from the Long Island shore at a point in Ravenswood a short distance above Hunter's Point, the Long Island Railroad Company will be allowed the use of the tracks leading into the Grand Central Station at Forty-second street, this city. In the new compact made this year for the use of the Grand Central Station, the Long Island Railroad has been included with the other roads. It is said that work on the tunnel will be commenced at an early day.

DIVIDENDS PAID FROM AMERICAN MINES DURING THE YEAR 1884 AND TOTAL TO DATE.

NAME OF COMPANY.	Location of mines.	Amount paid in 1884.	Total amount paid to date.
Adams, S. L	Colorado	$82,500	$82,500
Alice, G. S.	Montana	150,000	550,000
Atlantic, C	Michigan	40,000	260,000
Bassick, L. S.	Colorado	100,000	400,000
Big Bend Hydraulic, G	Dakota	72,000	114,000
Bodie Consolidated, G	California	350,000	1,645,000
Bonanza King Consolidated, S	"	150.000	175,000
Bulwer Consolidated, G	"	10,000	175,000
California, G	Colorado	31,500	96,500
Calumet & Hecla, C	Michigan	1,300,000	25,650,000
Carbonate Hill, S. L	Colorado	10,000	70,000
Catalpa, S. L	"	30,000	270,000
Central, C	Michigan	40,000	1,710,000
Chrysolite, S. L	Colorado	50,000	1,650,000
Contention, S	Arizona	62,500	2,587,000
Copper Queen, C	"	200,000	1,425,000
Cosmopolitan, S	Utah	25,000	75,000
Derbec Blue Gravel, G	California	60,000	60,000
Dunkin, S. L	Colorado	10,000	220,000
Father de Smet, G	Dakota	200,000	850,000
Franklin, C	Michigan	80,000	348,000
Hecla Consolidated, S	Montana	195,000	732,500
Helena, G. S. L. C	"	36,000	36,000
Homestake, G	Dakota	306.250	2,593,750
Honorine, S. L	Utah	12,500	12,500
Hope, S	Montana	36,000	171,635
Horn-Silver, S. L	Utah	1,200,000	4,000,000
Idaho, G	California	221,650	3,620,800
Iron Silver, S. L	Colorado	100,000	1,300,000
Jackson, G. S	Nevada	10,000	15,000
Kentuck, S	Nevada	21,000	1,288,000
Leadville Consolidated, S. L	Colorado	20,000	350,000
Lexington, S.	Montana	320,000	520,000
Little Chief, S. L	Colorado	40,000	760,000
Morning Star, S. L	"	25,000	640,000
Moulton, G. S.	Montana	80,000	80,000
Mount Pleasant, G	California	15,000	105,000
Navajo, S	Nevada	50,000	275,000
Ontario, S	Utah	900.000	6,050,000
Original, G. S	Montana	30,000	114,000
Oro Grande, G	California	174,860	248,533
Osceola, C	Michigan	62,500	972,500
Paradise Valley, G. S	Nevada	50.000	50,000
Plymouth Consolidated, G	California	600,000	950,000
Quicksilver Preferred, Q	"	12,900	666,900
Quincy, C	Michigan	280,000	3,804,000
Richmond Consolidated, S. L	Nevada	67,500	4,110,587
Rooks, G	Vermont	31,000	31,000
Security, G. S. L. C. I	Colorado	50,000	50,000
Sierra Bella, S	New Mexico	30,000	30,000
Sierra Buttes, G	California	15,064	1,465,997
Sierra Grande, S	New Mexico	160,000	860,000
Silver King, S	Arizona	50.000	1,350,000
Small Hopes Consolidated S. L	Colorado	800,000	800,000
St. Joseph's, L	Missouri	40,000	430,000
Standard Consolidated, G	California	75,000	4,675,000
Syndicate, G	"	60,000	60,000
United Verde, C	Arizona	60,000	97,500
Valencia Mica Company, M	New Hampshire.	15,000	15,000
		$9,305,724	$81,804,202

G., gold. S., silver. C., copper. L., lead. I., iron.

Amounts paid by mines located in the States and territories are as follows :

	In 1884.	Total to date.
Arizona	372,500	5,459,500
California	1,744,474	13,847,230
Colorado	1,349,000	6,689,000
Dakota	578,250	3,557,750
Michigan	1,802,500	32,804,500
Missouri	40,000	430,000
Montana	847,000	2 204,135
Nevada	198,500	5,738,587
New Hampshire	15.000	15,000
New Mexico	190,000	890,000
Utah	2,137,500	10,137,500
Vermont	31,000	31,000
Total	9,305,724	81,804,202

	In 1884.	Total to date.
Total amount paid by gold mines	$2,222,324	$16,690,580
" " silver mines	1,999,500	14,114,135
" " gold and silver mines	320,000	809,000
" " gold, silver, lead and copper mines	36,000	36,000
" " silver and lead mines	2,547,500	14,665,587
" " gold, silver, lead, coal, and iron mines	50,000	50,000
" " copper mines	2,062,500	34,327,000
" " lead mines	40,000	430,000
" " mica mines	15,000	15,000
" " quicksilver mines	12,900	666,900
Total	$9,305,724	$81,804,202

To Increase Power in Locomotives.—A newly-patented device for increasing the traction of freight-engines has recently been tested on the Rochester & Pittsburg road. It is asserted that it keeps the engine from slipping and saves rocking. The weight of the tender is thrown upon the engine. The engine making the test is a new one, of forty-two tons weight. Superintendent Gardner attached the engine to fifty-six empty cars, which were as difficult to haul as twenty-eight loaded ones. On the road near Titus Hill, where the grade is sixty-two feet to the mile, the engine was stalled. There was a wet track and a side wind. The engine held well to the track. Superintendent Gardner considered the test a satisfactory one. He said an engine without the attachment could not possibly do the work. The device may be used at will, so that when the engine is making fast time it is no hinderance. The Flint & Pere Marquette road has already adopted it.

NOTES ON COAL-DUST IN COLLIERY EXPLOSIONS.*

By E. S. Hutchinson, Newtown, Pa.

The subject of the influence of coal-dust in mine explosions has received considerable attention both in England and on the continent of Europe, but until the recent disaster at Pocahontas, Va., it seems not to have been of special interest to engineers in this country.

The reason, perhaps, is, that most of our bituminous mines are worked by short shafts, slopes, and drifts; few have been specially dry; and the explosions that have occurred could readily be traced to fire-damp with no complicated circumstances. The object of the present paper is to bring together, for the convenience of members of the Institute, the principal English opinions upon this important subject.

Messrs. Lyell and Faraday, in their report to the Home Secretary,† in England, on the Haswell Colliery explosion in 1844, seem to have been the first to point out that dust fed the flame originating in a fire-damp explosion, and that much of the carbon of this dust remains unburnt only for want of air.

The influence of coal-dust has been briefly referred to in some of the annual reports of the English mine inspectors; but general attention was first attracted to the question by the reading before the Royal Society of a paper on the Influence of Coal-Dust in Colliery Explosions, by William Galloway.‡ In it, he describes an apparatus he had erected at Llwynpia Colliery in the Rhondda Valley, Wales, which had been used for testing safety-lamps, and which he had adapted for his coal-dust experiments. Fresh air was allowed to enter into one end of a box and pass out at the other end into the up-cast shaft. A lighted lamp had also been placed in the box, and coal-dust was introduced from a hopper. The air was charged with coal-dust in various degrees, from a scarcely visible cloud to one that extinguished the flame of the lamp. Dust from steam-coal and also from highly bituminous coal was used—the finest and driest of each that could be obtained. Mr. Galloway concluded, after repeating his experiments many times, that, while the flame of the lamp seemed to be lengthened by the dust, "a mixture of air and coal-dust is not inflammable at ordinary pressure and temperature."

He then disconnected his apparatus from the up-cast, and introduced, by means of a small fan at one end, fire-damp from a blower, and air, which thus became thoroughly mixed; and found "that a mixture of 1 volume of fire-damp, and 15 volumes of air *was* inflammable, and that, with 16 volumes of air, it was *not* inflammable at 57 degrees Fahr.;" also, "that a mixture of fire-damp and air, in the proportion by volume of 1 of the former to 112 of the latter, becomes inflammable at ordinary pressure and temperature, when charged with fine dry coal-dust." (This represents 0·892 per cent of fire-damp.) He therefore considered it reasonable to conclude, "that an explosion, originated in any way whatever, in a mine of this class, may extend itself to remote parts of the workings, when the presence of fire-damp is unsuspected."

In June, 1876, a paper by Messrs. Henry Hall and George Clark was read before the North of England Institute of Mining Engineers§ on the Mechanical Effects of Blown-Out Shots in Ventilation. Their attention seems to have been called to the matter by an accident at Wynnstay Colliery, near Raubon, North Wales, April 24th, 1873, by which two men lost their lives from the effects of a blown out shot at the distance of 47 and 180 yards, respectively, from the initial point. It appeared in evidence at the inquest that the mine was inspected by the fire-boss and one of the managers daily, and that *no* fire-damp had been discovered before the accident or since.

The authors fired several shots from a strong iron tube with varying changes from the face of a brick-lined adit, 45 yards in length, with a sectional area of 30 feet. Gauze sheets were hung at intervals of 15 feet, and powder was distributed in the adit; but in no case was the gauze or powder burned beyond 5 yards from the face. The flame traveled no farther even when the explosion burst the tube. When the floor was thinly covered with dry coal-dust for 8 or 9 yards from the face, gauze sheets and powder placed as before, and a 2½-pound shot fired, the sheets and powder to 60 feet distance were all burnt, and the blast at mouth of adit—45 yards distant—was very fierce, lifting and driving for 15 yards a metal pipe weighing about 50 pounds, and moving a coal-car on the pit-heap, 75 yards distant.

For the last shot, with 2½ pounds of powder, dust was scattered on planks, the whole length of the adit. In this case, the flame issued strongly at the mouth of the adit and the blast was fatally fierce. The floor and roof were very wet, and the temperature was 50 degrees.

These gentlemen concluded, as the result of their experiments, that if coal-dust be present, even in a comparatively damp mine, the flame from a blown-out shot may travel 50 yards; and that in a dry mine of a high temperature, this distance would be greatly exceeded.

In April, 1878, Messrs. D. P. Morison and A. Freire Marreco read a paper before the Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers,‖ entitled Results of Some Experiments on the Effect of Coal-Dust in Colliery Explosions, in which they gave an account of experiments they had made at Elswick Colliery, in August, 1876. They used a box about 8 feet long and of proportionate width, with a brattice running up the middle, so constructed as to represent a working-place. Two miniature cannon were fitted into the end of the box, from which charges of powder of different sizes were fired, to represent blown-out shots. The first experiments were with a clean box, and without coal-dust. No effect was produced beyond the report and smoke.

They next experimented with coal-dust sprinkled on the floor and blown against the sides, brattice, door, and props. Sixteen trials were made with shots varying in weight from 30 to 120 grains. In several of these, props and brattice were blown down, the dust was fired, and flame projected from the windows. (It will be remembered that this was a mixture of air and coal-dust, and no fire-damp or gas.) The writers concluded, as the result of their labors, that not only was coal-dust inflammable under such circumstances, but that, with the double shot, one following the other before the dust raised by the first had time to subside,

* A paper read at the Chicago Meeting of the American Institute of Mining Engineers, May, 1884.

† *Philosophical Magazine*, 1845. ‡ Proc. Roy. Soc., March 2d, 1876, vol. xxiv., p. 239.

§ Trans. North of England Inst. of Min. and Mech. Eng., vol. xxv., p. 239.

‖ Trans. Chest. and Derb. Inst. Min., Civ., and Mech. Engineers, vol. v., p. 267.

the effects of the explosion were much more intense. They inferred, also, that the danger of shot-firing was greatly increased in a dry and dusty mine, in the atmosphere of which was an infinitesimal quantity of fire-damp. So far as their knowledge extended, the heavier disasters had invariably occurred in dry and dusty mines, while in those in which the dust had been laid by dampness, the explosions had been only local.

The authors then describe the explosion in 1866 at the Pelton Colliery, at which Mr. Morison was resident engineer. The seam had been worked a comparatively short time, and was unusually dry. The air, during working-hours, was charged with fine coal-dust, presenting almost the appearance of a fog. Though known as a "fiery" seam, it was well ventilated, and gas was seldom observed. Some traces of fire-damp had been observed following a heavy fall of roof, and the miner in that place was warned to withdraw his Davy lamp carefully. Another miner, in a heading not far distant, had also seen indications of gas in his lamp. An explosion occurred by which twenty four lives were lost. Some of the bodies were charred, most such cases occurring far away from the central point of the explosion, and in places where gas could not have entered. In nearly every portion of the seat of the disaster, the sides and roof of the galleries and rooms, as well as the props, were coated with fine coke, from ¼ to ⅜ inch thick. The initial cause was undoubtedly an explosion of fire-damp, which appeared to be aggravated and extended by the ubiquitous coal-dust.

In the discussion that followed, Mr. Thomas Evans (Chief Inspector of Mines for the Midland District) said he had always found that gas was the cause of explosions, and he never knew of one caused by a spent shot; and that he had no doubt but that coal-dust aggravated the results of explosions.

In *Iron*, in June, 1878,* Mr. William Galloway began the description of an accident at Llan Colliery, near Cardiff, Wales, December 6th, 1877, by which 17 men lost their lives. He entered the workings about 2½ hours after the explosion, and made a careful study during that day and the four succeeding days. Three 5-foot seams were worked with 24 feet of rock and shale between the upper and the middle, and 41 feet of fire-clay and shale between the middle and the lower seam.

No powder was used in the workings, owing to the extreme friability of the coal and intervening strata. All the testimony adduced showed that there was no accumulation of fire-damp in the workings within an hour before the explosion. On the two days next ensuing, Mr. Galloway found fire-damp in two cavities in the roof at points not readily accessible, and at a point in the upper seam approached by a chimney from the middle one. He assumes the initial cause of the disaster to have been a local explosion of fire-damp, caused by a naked light in one of the rooms in the middle seam. The deposits of coked coal-dust were well marked, extending through the middle seam level and along the cross-measure drift into the upper seam, into which they extended about 50 yards. Mr. Galloway finally concludes that the various phenomena are inexplicable, except on the supposition that a feebly explosive mixture of air and fire-damp and dust exploded, and the flame feeding on the dust filled the greater part of the workings in which the coked coal-dust was found. The coal of the middle seam contained 30 per cent of volatile matter.

Mr. Galloway considered also, that the weather being unusually cold, the air, having a low percentage of hygroscopic moisture, would, on attaining the higher temperature of the mine, absorb moisture, and thus render the dust abnormally dry and inflammable. This, however, is not an unusual state of things, as it must take place every winter in dry mines.

Mr. Galloway describes also an accident that occurred at Fowler's Steam Coal Colliery, Pontypridd, near Cardiff, October 21st, 1876.† Two colliers and a fireman were burned in the mine simultaneously with the firing of a shot that blew out. He visited the scene of the accident the same day, on October 23d, 28th, and 29th, and November 1st, and made a careful inquiry into all the attending circumstances. The coal is very hard and compact, and can not be advantageously worked without the aid of powder. It emits a good deal of fire-damp, so that locked safety-lamps are used, and special men are appointed to fire shots. Two miners were driving a cross-heading up an 18-degree slope, so as to connect a lower level with a sloping road driven in the solid. They made a side-cut, bored a shot-hole 3 feet 2 inches deep, and sloping upward at a sharp angle, and charged with 1¼ pounds of powder. The fireman made the usual examination at the face, and all retired. The shot blew out; and two of the men, 50 feet distant, around a corner, were knocked down and severely burned, one being permanently injured. The third, distant 60 yards, was also knocked down, but was only slightly burned. The brattice running up the middle of the heading was not disturbed. About 50 yards of the main heading were covered with coked coal-dust, but in the cross-heading this was found only at its foot. The flame extended about 7 yards farther from the origin than the last trace of coked coal-dust. The floor in front of the shot was covered with a quantity of small coal and dust to the depth of from 1 foot to 18 inches; and the theory is, that the incandescent gas from the blown-out shot, impinging against this combustible mass, fired it, with the results described. Mr. Galloway adds that, although there was no accumulation of fire-damp in any part of the workings, there must have been more or less of it constantly given off by the coal. Subsequent experiment showed that not less than 34 cubic feet per minute of fire-damp was entering the place when the shot blew out. This quantity, when the furnace was in full operation, would be at least 54 per cent of the total atmosphere, and might reach to 75 per cent.

On November 2d, 1878, Professor A. Freire Marreco and D. P. Morison read before the North of England Institute of Mechanical Engineers a paper entitled An Account of Some Recent Experiments with Coal-Dust.‡ These were carried on at Harton Colliery; the apparatus consisting of two boxes, one of which, about 12 feet long and six inches square inside, was fitted with two miniature cannon at one end and communicating at the other with an air-passage that could be regulated by a slide. The other box was about 10 feet long, communicated with the first at one end, and was open to the air at the other. Each side had three windows through which the length of flame could be observed. The boxes were so arranged that the current of air passed along the 12-foot box close to the cannon-face, and thence through the 10-foot box to the open air. One shot would be *against* the current of air and the other *with* it.

At the outset of their work, the authors were met by the inquiry, What is an *Explosion?* And this led them to seek for a dust to use in their apparatus, the result obtained with which should serve as a basis of comparison with other dusts under precisely similar conditions. Knowing the destructive results from the explosion of flour-dust, they adopted this as a standard of comparison. Forty-three experiments were made with 30-grain charges of powder, and two with 15-grain charges. The dust used was from various English, Scotch, and Welsh coals, from roadways and screens, and four kinds of flour-dust. In conducting these experiments, they soon found that it was perfectly easy to fire shots in the immediate neighborhood of coal-dust without producing any perceptible effect. They were also led to think that while, strictly speaking, they had not got, on this scale, what could be called absolutely an explosion, they had demonstrated, not only that coal-dust was capable of lengthening indefinitely the flame from a blown-out shot, but also that such a mixture might be made of air and dust as would not require for its explosion the initial flame of the burning gases from such a shot. Professor Marreco observed also that as finely powdered charcoal readily fires at an open flame, the volatile portions of the coal-dust might not be the only means of propagating an explosion.

In the discussion that followed the reading of this paper, Mr. Stephenson stated that in North Staffordshire, where a mine was dry, ventilation good, and no gas present, sufficient dust was produced, when the miners were at work, to show a "cap" on the flame of the safety-lamp, which was not the case after work had ceased for an hour or so.

Mr. William Galloway read a second paper before the Royal Society, in March, 1879,* in which he described a series of experiments at Llwynpia Colliery, with the return-air from the mine containing less than 2 per cent of fire-damp, which, he considered he had demonstrated, was rendered inflammable by coal-dust. His apparatus was placed close to the fan, in such a way that a current of air from the up-cast could be made to pass through it. An oil-lamp with a large flame was placed in the box, raising the temperature to about 74·5 degrees Fahr, and coal-dust was introduced through a hopper. The immediate result was the appearance of a large and very hot flame, the length of the visible part of which was from 6 to 8 feet, and it was accompanied by large volumes of black smoke and dust.

Other experiments were made with a specially constructed apparatus, to illustrate the effects of an explosion of fire-damp in a dry mine containing coal-dust. This apparatus consisted mainly of a box or gallery 79½ feet long and 14 inches square on the inside, and fitted up with a fan and other necessary appliances for introducing measured amounts of fire-damp and dust. The mixture of fire-damp and air was fired by the spark from a powerful magneto-electric machine. The temperature of the air-current within the gallery varied from 74 degrees at the firing end to 60 degrees at the other.

When there was no coal-dust in the gallery, the flame of the fire-damp explosion did not extend farther than from 7 to 9 feet; but when it contained coal-dust, scattered along the floor and on a few shelves, the flame of the explosion traversed its whole length and shot out into the air to a distance varying from 4 to 15 feet. Mr. Galloway found, as the result of his labors, "that a mixture of coal-dust and air will be *inflammable*, if it contains a larger proportion of fire-damp than 0·892 per cent;" that, "if it contains more than 0·892 per cent of fire-damp, it will be more and more explosive, according as the proportion of fire-damp is greater, until a maximum point is reached, beyond which its explosiveness will again begin to decline." Again, "If it contains less than 0·892 per cent of fire-damp, or even if it consists only of coal-dust and pure air, it will still be so nearly inflammable that it will probably become so when it undergoes the *compression* and consequent heating that an explosion must produce."†

On the 8th of September, 1880, an explosion occurred at the Seaham Colliery, in the County of Durham, England, by which 164 miners and others lost their lives. Professor F. A. Abel, Chemist of the War Department, was instructed by the Secretary of State for the Home Department to make examination of the dusts of the colliery, with the view of ascertaining what effect, if any, they had on the late explosion. Thirteen samples of carefully selected dusts were sent him, which, after having dried at 100 degrees Fahr., he passed through a screen of fifty meshes to the inch, to remove the coarser particles. The experiments were carried on at Garswood Hall Colliery, Brynn, near Wigan, in Lancashire.‡ The apparatus used was very similar to that employed by Mr. Galloway and Professor Marrecco, already described, although considerably shorter, being 28 feet from the dust-hopper to the end. The general fittings were of a simple nature, but great pains were taken to secure accuracy and uniformity in the velocity of the air-currents employed, in the proportions of gas used with the air, and in the intimacy of their mixture. The temperature of the air-current was maintained at from 75 to 85 degrees Fahr., by first passing through the tubes of a steam-boiler.

The sources of heat and flame were an uncovered Davy or Mueseler lamp, a wide gas-jet supplied with fire-damp from the colliery, and a small cannon fitted with electric fuse and charged with 80 grains of fine powder. The dusts were collected in different parts of the mine, from roadways, props, stones, screens, etc., and contained from 54 to 96 per cent of actual coal-dust, after being sifted and dried at 100 degrees Fahr.

(TO BE CONTINUED.)

Exports of Oil.—The exports of mineral oils from the United States during the eleven months ended November 30th, 1884, were 495,342,811 gallons, valued at $45,120,664. This, compared with the exports during the same period of the previous year, shows a decrease of 216,876 in gallons, and an increase of $984,104 in value.

* *Iron*, June 8th, 1878, vol. xi., p. 708.
† *Iron*, July 13th, 1878, vol. xii., p. 34.
‡ Trans. North of Eng. Inst. of Min. and Mech. Eng., vol. xxviii., p. 85, November 2d, 1878.

* Proc. Roy. Soc., vol. xxviii., p. 410, March 13, 1879.
† The apparatus was described by Professor Abel to be very ingenious; but he questioned whether the means of preventing the escape of minute quantities of fire-damp into the channel where the dust was raised were effective or not. In his subsequent paper, No. IV., Mr. Galloway estimates that this leakage would not amount to over one volume of gas to 7000 of air.
‡ Blue-Book, March 23d, 1881, Appendix.

FURNACE, MILL, AND FACTORY.

The Cummer Engine Company has just been awarded the contract for one of its Ballantine refrigerating machines for the Heim Brewing Company, of East St. Louis, Ill., and for a 95 horse-power engine, with outfit complete, to be used in the flouring-mill of Lee & Herrick, Crookston, Minn. Among the recent shipments of the Cummer Company are two refrigerating machines to Joseph Hensler, of Newark, New Jersey; a 350 horse power engine to Carlton, Foster & Co., Oshkosh, Wis.; a 95 horse-power engine to Edwin Groatz, of Henderson, New York; and a 130 horse-power engine to the Dominion Welding Company, Montreal, Canada. The company reports a rapid increase in its sales of the Jonathan Mills flour-dresser and the Finch roll.

The steel mill of the Bethlehem Iron Company, at Easton, Pa., which has been idle several weeks, resumed work January 5th.

The Terndale Car Company, near Catasauqua, Pa., has begun making 250 iron truck gondola cars for the Lehigh Valley Railroad Company. The prospects are, that the works will be kept in operation all winter.

The Lehigh Zinc-Works, at South Bethlehem, Pa., has just received a large order that will for the present keep the works in full blast.

The McCullough Iron Company's rolling-mills, at Rowlandsville, Md., which were nearly destroyed by the floods of last June, have been rebuilt and resumed manufacturing sheet-iron January 5th.

Five of the largest tin manufacturing concerns in this country, Messrs. James, Aikman & Co., E. Ketcham & Co., F. Haberman, the Lalance & Grosjean Manufacturing Company, and the St. Louis Stamping Company, were incorporated December 10th, under the title of the Central Stamping Company. The officers are David H. James, President; Walter M. Aikman, First Vice-President; John H. Sprague, Second Vice-President; George W. Ketcham, Secretary and Treasurer; and Frederick Haberman, Superintendent of Manufacturing. The factories are in Brooklyn, Woodhaven, Newark, and St. Louis, and the general office is at No. 25 Cliff street, this city.

Reports from Pittsburg, Pa., state that the iron trade shows signs of reviving. Shoenberger's old mill and nail factory, the finishing and puddling departments and the bar-mill of Zug & Co., the Keystone Bridge Company's works, the Westinghouse Machine-Works, the Locomotive-Works, Oliver Brothers & Phillips's mill and others have resumed

It is stated that Gen. Samuel Thomas, President of the Thomas Iron Company of Philadelphia, has decided to spend $1,000,000 in the building of an iron furnace in Alabama. He is the owner of 20,000 acres of iron ore and coal land in that State.

The carpenter shop and bar-mill of the Penn Iron-Works at Lancaster, Pa., were damaged by fire January 3d; loss, $10,000.

The Miami Powder-Works, at Goss Station, near Springfield, Ohio, blew up January 2d, causing the instant death of an employé. It is supposed that grit in the powder produced friction that ignited it.

Sealed proposals will be received by the Water Board at Baltimore, Md., to twelve o'clock M., January 12th, for about 386 tons of cast-iron pipe from 1½ to 10 inches diameter, cast-iron fittings for same, brass stops and ferrules, and special castings of brass and iron.

The Etna furnace at Youngstown, Ohio, is blown out, and will probably remain idle until spring.

It is understood that, as soon as the legal difficulties of Brown, Bonnell & Co. are adjusted, a portion of the works will be converted into a steel-plant.

The plant of the Malleable Iron-Works at Youngstown, Ohio, were sold at receivers' sale January 7th. The buildings are substantially new.

It is expected that the improvements at the steel works at Cumberland, Md., will be completed in about a month, when they will be put into full operation, if trade warrants it.

The Southwark Foundry and Machine Company, of Philadelphia, has just issued its 1885 catalogue, in which it handsomely illustrates its well-known Porter-Allen engines, the Southwark high-speed engine, the Clerk gas-engine, and a large variety of pumps. Among the latter, we note the fly-wheel pumps that the company aims to produce at a price enabling it to compete with the direct-acting type. It manufactures the latter, also, fitting the pumps with the Adams valve, which consists of a single moving piece, and is thrown by steam alone. These direct-acting pumps are made in a large variety of styles for different service, mine and sinking-pumps being among the number. Among the other specialties, we note vertical blowing-engines, hydraulic presses, and a full line of sugar machinery, for which the company's predecessors were famous.

The extensive iron-works of Brown, Bonnell & Co., Youngstown, Ohio, resumed work in all departments January 5th.

Five departments of the Cleveland Rolling-Mill, Ohio, started up January 5th.

The Board of Managers of the American Iron and Steel Association held a special meeting at Philadelphia, Pa., January 5th, to fill the vacancy caused by the resignation of D. J. Morrell, President of the organization. B. F. Jones was elected President; James M. Swank, Vice-President; and George W. Cope, Secretary. The following changes were made in the Executive Committee of the Association: Percival Roberts, in place of D. J. Morrell; David Reeves, in place of A. B. Stone; and Frederick J. Slade, in place of Abram S. Hewitt. The latter still remains a vice-president of the association.

The Frick Company, at Waynesboro', Pa., manufacturer of steam-engines and agricultural machinery, has resumed work.

The Solar Iron-Works, of Clark & Co., at Pittsburg, Pa., started up in all departments January 7th.

It is stated that the North Chicago Rolling-Mill Company's mills in Chicago, Ill., will resume operations in about three weeks. The mills employ about two thousand men.

The eighteen-inch department of the Carnegie Union Iron Mills, at Pittsburg, Pa., has started up. Work will probably be resumed in all the other departments in a few days.

The Burke Manufactory, at Canonsburg, Pa., has received an order that will keep the works in operation for a year.

During the past year, the Colorado Coal and Iron Company's blast-furnaces were in operation only about ten months, and the product in pig-iron was 15,836 tons of 2000 pounds. The pig-iron was manufactured into castings, 653 tons; muck-bar, 3100 tons of 2240 pounds; nails, 63,350 kegs of 100 pounds each; spikes, 1570 kegs of 150 pounds each steel nails, 3598 tons of 2240 pounds each, and merchant bar iron and mine rail, 2785 tons of 2000 pounds each. The steel rail mill was in operation only about four and a half months. It was run only as orders for rails were received, but, owing to the depression in business, these orders were not sufficient to keep the mills running all the time. The company's pig-iron product for 1884 was only about 40 per cent of that of 1883. This was undoubtedly due to the small demand, and also partly to the strike among the coal miners that occurred last fall.

The requests from the continent and Great Britain for space in the forthcoming International Inventions Exhibition are much in excess of the area available. The allotment for America is likely to be trenched upon unless applications are immediately forwarded. The time has been finally extended for applications from the United States to January 31st, so that to reach here by that date they should be forwarded not later than January 20th. The British Consul in this city has been instructed to furnish the necessary forms of application.

It is said that H. C. Frick and others are about closing negotiations for the purchase of the rolling-mill at Scottdale, Pa.

The next annual meeting of the National Association of Stove Manufacturers of the United States will be held on February 4th, in Chicago.

The Riverside Steel-Works, at Benwood, West Va., January 7th discharged 200 men on account of lack of orders. It is said that the Bellaire mill will make the same reduction soon. All the Wheeling mills will be reopened next week.

It has been stated that Carnegie Brothers & Co. will fire up their large blast-furnaces at the Edgar Thomson Steel-Works plant at Braddock, Pa. They will make pig-iron for the Western Pennsylvania market. They expect to utilize the iron in the mill cinders, the quantity of which now at the mill is estimated at 45,000 tons.

LABOR AND WAGES.

Messrs. C. G. Hussey & Co., of the Pittsburg Copper and Brass Rolling-Mills, inform us that in our last issue we made a mistake when we stated that the reduction of wages at their works was fifteen per cent. It was only ten per cent.

A call has been issued for a State Convention of Knights of Labor, to be held in Decatur, Ill., on the 15th inst., when it is proposed to organize a State association and form a Workingmen's State Legislative Committee.

Six hundred men and boys have struck at Belmont Colliery, Pa., against a reduction of ten per cent. The colliery is operated by S. S. Bickle & Co.

The Philadelphia & Reading Railroad Company has made reductions in the wages paid on the New Jersey Central Division. The reduction affects all employés except conductors, engineers, firemen, baggage-masters, and brakemen. Trackmen who now receive 99 cents a day, and all those employed at the rate of $500 a year and under, are reduced 8 per cent. Salaries ranging from $500 to $1000 are cut down 10 per cent, and all above $1000, one fifth.

Ford & Kimball, proprietors of the largest iron foundry in Concord, N. H., have discharged all but five of their employés.

A reduction of from 10 to 25 per cent has been made in the steel-works at Coshocton, Ohio.

The Pittsburg Bessemer Steel Company at Homestead, Pa., has reduced wages thirty-three per cent of the men in the rail mill, those in the converting mill twenty per cent, and the laborers ten per cent.

The employés of the Keystone Bridge Company of Pittsburg, Pa., have accepted a ten per cent reduction.

The employés of the Oxford Iron Company, at Oxford, have been notified that, if they submit to a reduction of 20 per cent in their wages, the works will resume. The men are in doubt whether much work will be done before April, and are not anxious to reply to the offer.

All the employés of the Glendon Iron Company, at Easton, Pa., except the common laborers, have been notified of a reduction in wages of from 10 to 12 per cent on February 1st.

Pardee & Co., coal operators at Hazleton, Pa., have notified their employés that they will be paid in 1885 on the plan pursued since 1880, and that they will announce monthly the wages the miners and laborers will receive that month.

The Western Nail Mill at Belleville, Ill., running 150 machines, announces a cut of from thirty to thirty-five per cent. The establishment employs about 600 men.

The Frick Manufacturing Company at Waynesboro', Pa., has reduced wages from 10 to 15 per cent.

Secretary Martin, of the Amalgamated Association, states that the scale for this year at the Bessemer Works at Homestead, Pa., has been signed, with a reduction of 15 per cent in the blooming and 12 per cent in the converting department, and that, as the plant has not for some time been regarded as a rail mill, the 33 per cent reduction in the rail mill demanded does not affect the wages of that class of other Bessemer plants.

Oliver Brothers & Phillips, iron manufacturers at Pittsburg, Pa., controlling four mills, have ordered a reduction from 10 per cent to 12½ per cent in the wages of all their employés except those governed by yearly contracts. The reduction will affect between 3000 and 4000 men, and will go into effect in a few days.

The coal miners' strike at the various mines in New Mexico has been settled by arbitration, and all, save the miners at Gallup, on the line of the Atlantic & Pacific, have gone to work.

The State Convention of coal miners in Ohio, January 7th, had delegates representing 8000 miners. A limited number of the delegates are in favor of a reduction from 70 to 60 cents, which would be in the nature of a compromise with the Hocking Valley operators, who refuse to pay over 50 cents. A majority of the convention, however, are opposed to this. President McBride urged the convention to advise the miners to stand firm, as the trades unions in all parts of the country had promised aid.

Reports state that agents of the Hocking Valley mines are at work at Lynchburg, Va., securing negroes to take the places of the striking miners. Seventy-five left for the mines January 6th, and others

have been secured. They sign a contract for one year before leaving.

Wages at the Quincy copper mine, Michigan, have been reduced 10 per cent.

RAILROAD NEWS.

Owing to the depression in the iron business, several trains on the Lehigh Valley Railroad were discontinued January 5th. Among the suspended trains was the one that hauled all the iron shipped by the Thomas, Crane, Parryville, Bethlehem, Coleraine, and Glendon iron companies, and which had not been idle a day in nineteen years. One of the other trains taken off carried coal to the furnaces along the road.

The Consul of the United States at Paso del Norte has reported on the trade developed by the completion of the Mexican Central Railroad. The exports from that customs district to the United States for the year ended June 30th, 1882, were $8424; for 1883, $52,117; and for 1884, $3,704,688. Of this amount, about $3,000,000 was coin and bullion.

The Norfolk & Western Railroad Company has arranged for the development of the bituminous coal-fields of Southwest Virginia on a large scale, and has constructed a large shipping pier at Lambert's Point, near Norfolk, which is equipped with 34 loading chutes. The output of the mines in the Pocahontas Flat-Top bituminous coal district is said to be 4000 tons a day. Several branches of railroad have been built to connect with the New River Division of the Norfolk & Western. It is stated that an agreement has been entered into by the company with Castner & Co., Limited, of Philadelphia, to be the sole agents in that city, New York, Boston, and Baltimore for handling all the company's tide-water coal trade. The agreement requires that they shall establish agencies, not only in this country, but in other countries, for the sale of the Pocahontas Flat-Top coal.

The Tennessee Coal, Iron, and Railroad Company's report for December shows coal received directly from the mines 15,030 tons; coke, 8061 tons; making a total for 1884 of coal 152,308 tons, and of coke 100,935 tons.

The Utah Central Railroad during the past year transported 81,495 pounds of coal from Ogden to Salt Lake City and the smelters south of that city. From Provo, the road took north and south 58,875,835 pounds of coal, making a total of 140,371,535 pounds.

The Pennsylvania and Baltimore & Ohio railroad companies have practically arranged the details for pooling the soft coal coming to tide-water at Boston, Philadelphia, and New York. The agreement, unless something unforeseen occurs, will be signed in a few days, and will give the Baltimore & Ohio 45 per cent and the Pennsylvania 55 per cent.

Surveyors of the Lackawanna & Pittsburg Company are at work on a route from Savona, on the Erie, along the east bank of Lake Keuka, and from Penn Yan to Waterloo—a line forty miles long. This would give a direct line from the oil-fields of Pennsylvania to the West Shore and New York Central railroads.

COAL TRADE NOTES.

CANADA.

PROVINCE OF NOVA SCOTIA.

Coal shipments from the various mines of Cape Breton during the year 1884 were: Sydney mines, 127,008 tons; reserve mines, 84,000 tons; International and Gowry, 80,000 tons each; Port Caledonia, 65,000 tons; Lingan, 20,484 tons; Block House, 19,000 tons; Victoria, 5993 tons; Barracois, 130 tons.

COLORADO.

The output of the coal mines up to July 31st amounted to 1,352,373 tons. The extensive strike among the coal miners during the latter portion of 1884 resulted in closing down almost every mine.

MARYLAND.

The shipments from the mines of the Cumberland coal region for 1884 aggregated 28,488,920 tons—an increase of 366,692 tons over 1883. The year's shipments were the heaviest in the history of the Cumberland region, exceeding the largest previous year—1873—by 175,000 tons.

MISSOURI.

A destructive fire at Elliott, a mining village near Noberly, has caused a loss to the Osage Coal and Mining Company estimated at about $100,000.

NEW YORK.

It is reported that New York capitalists have raised $25,000 to work the anthracite coal claimed to have been found at Portland, provided the right of way can be obtained.

J. Noble Caldwell, surviving partner of the firm of J. W. Caldwell & Son, wholesale dealers in coal at No. 111 Broadway, has made an assignment, giving preferences for $9310.

PENNSYLVANIA.

ANTHRACITE.

On account of the decree of the coal combination limiting the shipment of coal by the Delaware, Lackawanna & Western Company to one million five hundred tons during January, the company has suspended operations at the Bellevue, Oxford, Scranton, and Hampton mines.

The Delaware & Hudson Canal Company has suspended work at eight mines between Plymouth and Carbondale.

The Pennsylvania Coal Company has suspended work at some of its mines, and smaller operators in the Lackawanna and Wyoming regions have done the same.

The Lehigh Valley Coal Company has made a mortgage for $500,000 to the Girard Life and Trust Company, as trustee for the holders of bonds of this amount, which has been recorded in Center County. The security is the tract of bituminous coal lands known as the Snow-Shoe tract, which was bought last year by the Lehigh Valley Company for about one million dollars. These bonds do not increase the debt of the company, but are issued to refund at a lower rate of interest the bonds that were on the property at the time of purchase. The new bonds are registered, $500 each, bearing five per cent interest, payable January and July, and mature in 1910. A sinking fund is provided by a charge upon the tonnage mined.

The firm of Haddock & Steele, operators of extensive collieries at Plymouth, was dissolved January 8th. The members of the firm are John C. Haddock and Charles F. Steele, both of Brooklyn. Haddock will continue to operate the Dodson Colliery, but the other collieries and property of the firm will be sold. The firm employed about 2000 men.

COKE.

The Connellsville coke syndicate has practically gained entire control of the coke trade of that section by the purchase, for $150,000, of the coke-works of G. W. Moore & Co., which operates 313 ovens.

NATURAL GAS.

An application has been made at Philadelphia for a writ of *quo warranto* against the Westinghouse or Philadelphia Gas Company, to show by what authority it is proceeding to furnish gas for fuel and heat in the city of Pittsburg. The application was made on behalf of the Fuel-Gas Company. The decision will not be given until after the opinion of the Supreme Court is rendered on cases pending.

RHODE ISLAND.

A portion of the coal mine at Portsmouth caved in January 1st. This mine has been worked for over twenty years, but a little over one year ago it was abandoned because it did not pay, and the pumps were stopped.

TENNESSEE.

The coke-ovens at the Soddy mines, in Hamilton County, 350 in number, have resumed operations.

WEST VIRGINIA.

Messrs. H. G. Davis & Brother have purchased the Virginia mine, including the entire stock of the company. This property is located a few miles from Piedmont, and contains the big or 14-foot vein of coal. The property has not been worked for some years.

NATURAL GAS.

Natural gas is stated to be so abundant at Macksburg that the proprietors of oil-wells furnish the gas for $2 a month for fire, without regard to the quantity used.

GENERAL MINING NEWS.

ARIZONA.

PIMA COUNTY—QUIJOTOA DISTRICT.

The Peer, Peerless Combination, and Weedom Mining Companies have held their annual meetings at San Francisco. The following directors and officers were elected to serve for the ensuing year: W. S. Lyle, President; R. H. Follis, Vice-President; J. W. Flood, J. W. Mackay, J. B. Low, the same in each mine: Aug. Waterman, Secretary: and W. H. Smith, Superintendent. The new drills were to have been in operation by this time.

CALIFORNIA.

NEVADA COUNTY.

RISING SUN.—The company has purchased the westerly extension of the Jackson quartz mine. It will consolidate this with the Cocktail claim, in which it is part owner, and work the consolidation through the Rising Sun shaft.

SAN BERNARDINO COUNTY.

BELLE MCGILROY.—It is stated that there is enough ore on the various dumps and in sight to justify the owners in putting up reduction-works.

BONANZA KING.—The mine is opened to a depth of about 600 feet. It is intended to increase the milling capacity and to develop part of the company's claim.

CANADA.

PROVINCE OF NEW BRUNSWICK.

BRUNSWICK ANTIMONY.—The company, having failed to collect the assessment of one dollar a share levied last July, now offers $150,000 six per cent bonds to its stockholders for subscription. The directors—John J. Marsh, Walter L. Frost, Silas Peirce, André Cushing, and Thomas Saunders—agree to take $75,000 of the bonds. Subscriptions are not to be binding until $125,000 shall have been subscribed. The company gives capital stock as a bonus to subscribers.

PROVINCE OF ONTARIO.

CLEVELAND MINING COMPANY, LIMITED.—This company has been incorporated with a capital stock of $750,000, divided into 7500 shares of $100 each. Operations will be carried on in the counties of Hastings and Peterboro', while the chief place of business will be at Trenton.

COLORADO.

The value of the mining product of this State for the year 1884 is estimated at $20,750,000. Total production in 1883, $26,306,131, showing a decrease in 1884 of $5,556,131.

CLEAR CREEK COUNTY.

The Public Sampling-Works at Idaho Springs, in operation since May 1st, purchased up to December 31st, 1884, the following:

		Valuation.
Silver	82,419·61 ounces.	$90,661.57
Gold	2838·03 "	56,760.60
Lead	103,235·10 pounds.	37.164.60
Copper	57,919·60 "	7,529.54
Total		$192,116.31

FREMONT COUNTY.

ROYAL GORGE SMELTER.—These works have been in operation only a part of the year, and the output is as follows:

Gold, ounces	865.959·00	$17,319.31
Silver, ounces	88,264.17	95,868.48
Lead		39,834.06
Total		$153,021.85

The total output in 1883 amounted to $177,602, showing a decrease in 1884 of $24,580.

GILPIN COUNTY.

The sampling-works of E. G. Nagle, at Black Hawk, report that during 1884, 17,768,000 pounds of ore were received at the works, valued at $467,096.

HINSDALE COUNTY.

The production for 1884 amounted to $204,918.

VERMONT.—The mine has been closed down.

JEFFERSON COUNTY.

GOLDEN SMELTING COMPANY.—The production for 1884 is reported as follows:

Localities.	Gold.	Silver.	Lead.	Totals.
Gilpin Co	$180,446	$60,545	$6,462	$247,453
Clear Creek Co	7,696	228,145	48,533	284,375
Boulder Co	76,386	18.839	428	95,855
Lake Co		42,236	13,941	56,178
Summit Co	475	1,196	1,420	3,092
Park Co	141	376		518
Saguache Co	81	1.544	5,440	7,066
New Mexico		3,859		3,859
Miscellaneous	8,238	5,387	5,150	18,876
Totals				$717,172

The total production in 1883 was $734,190, showing a decrease in 1884 of $17,018.

LAKE COUNTY.

The following statements have been published by the Leadville *Herald*: The output of Leadville for the year 1884 was $12,837,497. In this total, the yield of gulch and placer mining is not considered, neither is any deduction made for ore received from outside camps. The one would probably offset the other. The reduced prices of silver and lead have

materially affected the total money value of the output. Every thing considered, the showing for the year is a good one, with an encouraging outlook for 1885.

The amount of ore on hand at the different smelters is not as great as it was a year ago. Shipments from the mines have been light for the past ten days, owing to the heavy snow-falls.

PRODUCTION OF THE LEADVILLE SMELTERS AND MILLS DURING 1884.

NAME OF WORKS.	Tons of lead.	Ounces of silver.	Oz. of gold.	Value.
Ark. Valley smelter	8,978	1,404,157	5,764	$2,315,286
American Smelter	8,000	775,000	5,500	1,500,000
Harrison Reduc.-Wks.	5,962	935,124	1,434	1,492,542
La Plata Smelter	5,187	1,568,668	2,466	2,153,505
Fryer Hill Smelter	4,544	617,955	3,412	885,695
Manville Smelter	2,625	420,000	1,050	676,415
Ore, Antioch, etc	....	.....	3,000	60,000
Totals	35,296	5,720,904	22,626	$9,083,443

During the past year, the Leadville smelters did not average over two thirds of their working capacity. The calculations on silver were made at 2½ cents an ounce less than in 1882, and the same as the calculation for 1883, namely, $1.10 per ounce. The calculations for lead are made at $73 per ton, while in 1883 this metal was calculated at $86 per ton, and in 1882 at $100 per ton. It will thus be readily seen that the output of our mines compares favorably for 1884 with the greatest years we have ever had. The difference in the prices of the metal would show a marked increase in the footings for the year, had there been no decline in prices. Silver closed for the year at $1.07¾ per ounce, and lead at $3.70 per 100 pounds.

The year 1885 will show great activity in mining circles. The developments made during the past year in lime formations, attended as they were with such favorable results, will encourage many mine-owners to make similar explorations. The large producing properties have immense bodies of ore in sight, and new producers are constantly added to the list.

LITTLE CHIEF.—At a recent meeting of the board of directors, it was decided to present Mr. Austin Blakey, foreman in charge, with $500, as extra compensation and in recognition of his fidelity to the interests of the company, in the management of the property under his charge in Leadville.

OURAY COUNTY.

The production of this county for 1884 is estimated at $1,300,000.

PITKIN COUNTY.

The production for 1884, it is estimated, amounted to $1,250,000.

The capacity of the smelter at Aspen is enlarging to one hundred tons. Roasters are also building. The smelter is buying all ores offered, the minimum charge for treating being $28 a ton, the average grade being 400 and 500 ounces. Great difficulty is experienced in procuring the necessary fluxes, coke, and coal for running the furnace.

PUEBLO COUNTY.

COLORADO SMELTING COMPANY.—The bullion production from January 1st to December 27th, according to published reports, was as follows :

Lead	13,933,524 pounds.
Silver	699,748 ounces.
Gold	746 ounces.
Valuation at smelter	$1,068,988

SAGUACHE COUNTY.

The total product of the iron mines for the year 1884, estimated by the amount consumed by the Colorado Coal and Iron Company, which is near 90 per cent of the total, was about 36,000 tons. This is, of course, exclusive of the iron used in smelters and in gas-works for the purpose of purifying the gas. Almost all the iron that is mined in this State for manufacturing purposes is consumed by the Colorado Coal and Iron Company. It is taken from its mines near Villa Grove, known as the Calumet and Hot Springs Mines.

SAN JUAN COUNTY.

Developments in this county during the past twelve months, says the La Plata *Miner*, have been of the most satisfactory nature, and without exception the people look forward to an unusually prosperous season during 1885. An even half-dozen of our best-known properties have succeeded, within the past sixty days, in cutting large and rich ore-bodies, in tunnels varying from 350 to 1500 feet in length, and at depths ranging from to 600 feet. In addition, some twelve or fifteen properties have been placed on the list of producers, one of them standing at the head of the county's largest producers. The ore-shipments from this county alone approximate 8000 tons, with a value slightly exceeding $750,000.

SUMMIT COUNTY.

ELK HORN.—An arrastra is to be built, for working the gold ore from this mine. It is stated that many others are contemplating similar enterprises.

ELYRIA.—These reduction-works, which have been idle for a long time, are now in successful operation.

KEYSTONE BULLION.—Work has begun.

DAKOTA.

LAWRENCE COUNTY.

FATHER DE SMET.—The report for the week ended December 18th is as follows : Inclosed please find express company's receipt for bar No. 198, containing 1065·30 ounces of gold, the result of run of mill for first half of December. At the mine, every thing is going ahead with its accustomed regularity. The severe cold weather interferes somewhat with our open cut work ; otherwise, have nothing to complain of, as regards breaking the ore and getting it to mill. West cross-cut, third level, is improving in quality as the work advances, and the chances seem extremely good for developing a large body of fair milling ore here. The mill is running very regularly, and so far is not affected by the cold weather. For the week ended January 1st, we extracted ore from the first, second, and third levels, 2980 tons. Ore milled, 3000 tons. West cross-cut, third level, advanced 6 feet ; total length, 30 feet.

IDAHO.

The total output of the mines of Alturas County for the year 1884 is estimated at $4,000,000.

The past year has been one of experiment and building. Smelting-furnaces have been constructed in one place and shut down in others ; several hoisting and concentrating-works have been constructed, roasting-furnaces built, and new mines discovered. But most of this was not ready for use until too late to make much of a showing this year. The prospects for 1885 are very favorable.

IDAHOAN.—The English syndicate that purchased this mine was to have made the first payment the 15th of December, but failed to do so. It is expected, however, that the matter will soon be settled.

ILLINOIS.

Mining operations are carried on vigorously in the vicinity of Galena, and indications are, that more mining will be done the present season than for many years. Great quantities of dry bore and blackjack, a few years ago regarded as worthless, but now used by zinc smelters and paint manufacturers, are raised.

MICHIGAN.

COPPER MINES.

CALUMET & HECLA.—In 1884, the product of mineral amounted to about 39,800,000 pounds of ingot.

FRANKLIN.—The product of mineral for 1884 amounted to 4,603,540 pounds. This gives a total product, in tons, of 2301 tons 1540 pounds in 1884, and 2102 tons 1315 pounds in 1883, an increase of 199 tons 225 pounds in 1884, compared with 1883. This makes a product of mineral of 54,802,112 pounds, or 27,401 tons 112 pounds since the record began in 1857. The product that year was 10,002 pounds, or 5 tons 2 pounds. The total cost of manipulating a ton of rock in January, 1884, was $2.56 ; in November, 1884, $1.95. The average cost in 1884, December estimated the same as November, was $2.22¾ ; the average cost in 1883, $2.40. The Franklin mine can produce copper at a profit with the market no higher than at present. It is out of debt, and has a valuable stock of supplies and copper on hand.

HURON.—The past year's product of mineral amounted to 2,386,328 pounds. This gives a product of 1143 tons 328 pounds in 1884, against 434 tons 1785 pounds in 1883, an increase of 708 tons 600 pounds in 1884. The gross product of the Huron, 1860 to date, is 14,402,213 pounds, or 7201 tons 213 pounds. The 1860 product was 25,069 pounds, or 12 tons 1069 pounds. The cost of manipulating a ton of Huron rock in January, 1884, was $4.30, and in November, 1884, $1.76. The average cost in 1883 was $4.52, and the average in 1884, December estimated, $2.75¾. Superintendent Vivian is reducing the cost of manipulating Huron rock to a scientific basis, and he is not far behind in the result as regards Franklin rock.

QUINCY.—For 1884, the product of mineral amounted to 6,882,635 pounds. The total product in 1881 was 6,815,485 pounds, and in 1880, 4,878,610 pounds. Reduced to tons, the 1880 product was 2439 tons 610 pounds ; the 1881 product, 3407 tons 1485 pounds ; the 1882 product, 3437 tons 230 pounds ; the 1883 product, 3370 tons 1150 pounds ; and the 1884 product, 3441 tons 635 pounds, an increase of 70 tons 1485 pounds in 1884, compared with 1883.

GOLD MINES.

EUCLID.—This gold mining company has sent ore to Chicago for a practical test. Should the result prove satisfactory, the company will, if favorable rates can be obtained, ship from 300 to 500 tons to the same works during the winter.

IRON MINES.

MCCOMBER.—A chattel mortgage for $16,000 has been foreclosed on the personal estate of this company, the mortgagee taking formal possession.

UNION.—This mine, at Crystal Falls, has been abandoned by the Union Iron and Steel Company, and the hoisting plant and other mining machinery and apparatus sold to the Cleveland Iron Mining Company, of Ishpeming. The reason for this act on the part of the company was the failure to secure a lower rate of royalty than that at which it had contracted to work the mine, which was 50 cents a ton. The mine has not been worked since the failure of the company, two years ago.

MONTANA.

LEWIS & CLARKE COUNTY.

The gold and silver received at the Helena Assay-Office for the past year amounted to $903,018.

CAPITAL.—A concentrator has just been built by the company. Its present capacity is fifty tons a day but it is so arranged as to be doubled. The mines owned and operated by this company are the Micawber, Coyne, S. P. Bassett, Providence, Susie, and Minnie Lea.

ELKHORN.—Active operations have been carried on for the last ten months, and during that time 3304 tons of ore have been treated in the ten-stamp mill and the net results have aggregated $168,425.45, or a saving of about $51 per ton of ore, which averaged only about 55 ounces per ton originally. The average amount of ore treated daily in the mill is eleven tons, and it is stamped very fine and amalgamated in a combination pan without grinding. The bullion produced is about 700 fine in silver, with a little gold in it, the principal alloy being copper.

MONTANA COMPANY, LIMITED.—The present manager has thoroughly reorganized the working forces of the Drum Lummon, and greatly reduced the extraordinary expenses that characterized the late Atwood administration. Reports say that there is a large supply of good ore in the mine, and since operations are to be carried on carefully and economically, it is thought that the company's affairs will soon be in a prosperous condition.

SILVER BOW COUNTY.

The output of Summit Valley District for 1884 is estimated at $16,000,000.

ANACONDA.—The smelter has been closed down.

RISING STAR VS. SILVER SAFE.—A suit has been commenced at Butte by Walker Brothers, owners of the Rising Star, to recover from W. A. & J. R. Clark, the owners of the Silver Safe, $100,000 for ore, alleged to have been extracted by them from the Rising Star mine ; also, twenty-five thousand dollars for damage to the property. The case is one in which a rich mineral vein is claimed by both parties, the apex being on the property of the defendants and a large portion of the ore-body dipping beneath the claim of the plaintiff.

NEVADA.

STOREY COUNTY—COMSTOCK LODE.

ANDES.—The machinery has been put in order, and every thing is in readiness to resume operations.

KEYES.—Developments continue to be satisfactory. Stoping out ore will begin as soon as the ledge is reached.

OVERMAN.—Work has been suspended. The reason assigned is, that the ore taken from the upper levels proved to be of too low a grade to pay a profit after deducting the cost of mining and milling. About 4000 tons of ore have been taken out of the upper

levels in the past three months, which was crushed at the Vivian mill, on the Carson River.

UTAH.—The mine has been shut down. The want of funds is said to be the cause.

NEW YORK.

ULSTER COUNTY.

According to press dispatches, some New York capitalists have worked mineral deposits in the vicinity of Ellenville, and propose to erect works for the manufacture of sulphuric acid on an extensive scale.

UTAH.

Wells, Fargo & Co.'s statement of the mineral of Utah for 1884 :

BASE BULLION.	Lbs. lead refined	Lbs. lead unrefined	Oz. fine silver.	Oz. fine gold.
Germania Lead Works	4,840,987	1,513,455	60,264	292
Hanauer	...	12,390,865	651,699	2,138
Horn-Silver Mining Co.	...	22,380,027	1,435,696	...
Mingo Furnace Co.	...	11,860,446	326,579	1,111
Net product base bullion	4,840,987	48,144,793	2,474,238	3,541
Lead, silver, and gold in ores shipped	...	7,879,100	776,421	265
Matte containing copper..63,372 lbs.	...	...	3,325	...
Total base bullion and ores. 63,372 lbs.	4,840,987	56,023,893	3,253,984	3,806
DORE BARS.				
Germania Lead Works			283,982	685
Ontario Silver Mining Co.			1,879,567	...
Silver Reef District			234,563	...
Other mills and places			17,392	1,039
Total Doré bars			2,415,504	1,724

RECAPITULATION.

4,840,987 lbs. refined lead, at 3½ cents per lb	$169,434.54
56,023,893 lbs. unrefined lead, at $35 per ton	980,418.12
5,669,488 oz. fine silver, at $1.08 per oz.	6,123,047.04
5,530 oz. fine gold, at $20 per oz.	110,600.00
63,372 lbs. copper, at 10 cents per lb.	6,337.20
Total export value	$7,389,836.90

Computing the gold and silver at its mint valuation, and other metals at their value at the seaboard, it would increase the value of the product to $9,301,508.

A meeting was recently held at Salt Lake City for the purpose of discussing the silver question. Three delegates were appointed to attend the convention in Denver, Colorado, January 28th.

JUAB COUNTY.

The trouble between the Eureka Hill and Bullion, Beck, and Champion companies hinders progress and keeps a number of miners idle at Tintic.

RED BIRD.—This mine, adjoining the Eureka Hill, has been sold for $39,000.

SALT LAKE COUNTY.

At Bingham, the past year witnessed an output of 25,000 tons. The Brooklyn, the Lead, and the Yosemite are doing well, and the Old Telegraph, the Spanish, the Nast, Winnamuck, Dixon, Tiewaukie, South Galena, Last Chance, Silver Shield, Alameda, Live Pine, and twenty other mines are worked to advantage in a small way. The Lucky Boy is opening, and will no doubt soon begin to ship ores. The Flagstaff is reorganizing. At the very deepest workings in this mine, the ground was very favorable for new ore-bodies. The City Rock is in shape for large production.

SUMMIT COUNTY.

CRESCENT.—The sampler and concentrator have started up.

JOHN C. DALY.—The company's mine has been opened to the sixth level, and shipments of high-grade ore have begun.

TOOELE COUNTY.

HONORINE.—The concentrating-works have been shut down through want of water, and will remain closed for the winter. While work is suspended, however, interior repairs will be prosecuted. Work at the mine continues.

WISCONSIN.

ASHLAND COUNTY.

SUPERIOR IRON COMPANY.—This company has been incorporated, with a capital stock of $500,000, for the purpose of mining iron ore.

FINANCIAL.

NEW YORK, Friday Evening, Jan. 9.

The mining market during the past week has shown a slight improvement. The dealings have been larger than for some time, and the prices, in almost all cases, have shown an upward tendency. The sales were 37,350 shares, against 29,715 shares for the preceding week, showing an increase sales of 7635 shares.

The main interest was again centered in Horn-Silver, and sales of 7505 shares were made at various prices ranging from $2.65@$3, and closing at $2.70.

Albion Consolidated has been the feature of the Nevada stocks. It opened at 12c., and closed at 15c.; 3200 shares changed hands. A small business was done in Eureka Consolidated at from $1.20@$1.40. Although the prospects of the Comstock mines are not very bright and great difficulty is experienced by some of the companies in collecting the assessments so regularly levied, the interest does not grow less. Consolidated California & Virginia and Sutro Tunnel were actively dealt in, the price of the former ranging from 34 @36c., and that of the latter from 10@11c. Sierra Nevada, Hale & Norcross, and others also received attention.

Robinson Consolidated appears again on the list, with a small business of 200 shares at 35c. Amie Consolidated shows sales of 5000 shares at from .03@ .04c. The price of Chrysolite shows a downward tendency. It opened at 90c. and closed at 83c., with sales amounting to 1100 shares. Bassick and Colorado Central were also lower, with a small business.

Standard Consolidated sales amounted to 2420 shares. The reports from the mines show no new developments. The price has been lower, at from 44@60c., closing at 44c. Bodie Consolidated, Bulwer, and Consolidated Pacific show the usual amount of sales, with no special features. Plymouth Consolidated, which during the week sold as high as $16.63, has dropped to $15.25, and closed at that price; the sales amounted to 1790 shares. Occasional transactions are reported in Alice, Moulton, Father de Smet, Caledonia, and Silver King, at steady and high prices. A complete summary of the market will be found elsewhere.

The Deer Creek Consolidated Mining Company has been chartered, with the principal office in Philadelphia. It will develop mineral and other lands in Idaho. The capital stock is $200,000.

MEETINGS.

The annual meetings of the following companies for the election of trustees and the transaction of business will be held at the times mentioned :

American Steam-Boiler Insurance Company, No. 45 William street, New York City, February 17th, from twelve o'clock M. to one o'clock P.M.

Beaton Silver Mining Company, Room 67 Stewart's Building, corner of Broadway and Chambers street, New York City, January 13th, at one o'clock P.M.

Bessemer Mining Company, No. 345 Broadway, New York City, January 13th, at eleven o'clock A.M.

Big Bend Hydraulic Mining Company, No. 181 Broadway, New York City, January 13th, at eleven o'clock A.M.

Chihuahua Smelting Company, Mills Building, No. 15 Broad street, New York City, February 2d, at two o'clock P.M.

Columbus Mining Company, Tribune Building, No. 154 Nassau street, New York City, January 14th, at twelve o'clock M.

Dona Maria Mining Company, No. 28 Bond street, New York City, January 16th, at twelve o'clock M.

Dudswell Gold Mining Company, Fifth Avenue Hotel, New York City, January 15th, at twelve o'clock M.

Fuel-Gas Company, No. 102 Fourth avenue, Pittsburg, Pa., special meeting for the purpose of voting for or against an increase of the capital stock, January 23d, at eleven o'clock A.M.

Hecla Powder Company, No. 239 Broadway, New York City, January 20th, at ten o'clock A.M.

Hite Gold Quartz Company, office of Barton S. Weeks, No. 54 Wall street, Room 23, New York City, March 7th, at three o'clock P.M.

Midland Mining Company, No. 54 William street, New York City, January 14th, at twelve o'clock M.

Minas Prietas Mining Company, No. 18 Wall street, Room 45, New York City, January 15th, at twelve o'clock M.

Pottstown Iron Company, No. 400 Chestnut street, Philadelphia, Pa., January 15th, at twelve o'clock M.

Somberete Mining Company, No. 18 Wall street, Room 45, New York City, January 16th, at ten o'clock A.M.

Standard Vapor Fuel Iron and Steel Company, No. 53 Broadway, New York City, January 13th, at twelve o'clock M.

Yedras Mining Company, No. 18 Wall street, Room 45, New York City, January 16th, at ten o'clock A.M.

DIVIDENDS.

Big Bend Hydraulic Mining Company, of Dakota, has declared dividend No. 20, of $6000, payable January 5th.

Little Schuylkill Navigation Railroad and Coal Company, of Pennsylvania, announces a dividend of three and a half per cent, payable January 16th.

Navajo Mining Company, of Nevada, has declared a dividend of 25 cents a share.

Plymouth Consolidated Mining Company, of California, has declared a dividend of $50,000, payable January 9th.

Westmoreland Coal and Coke Company, of Pennsylvania, gives notice that the coupons of the first mortgage loan will be paid on demand at the Merchants' National Bank at Philadelphia, Pa.

PIPE LINE CERTIFICATES.

Messrs. Watson & Gibson, petroleum brokers, No. 49 Broadway, report as follows for the week :

Last Saturday, the market sold up to 75½c., but since that time there has been a gradual decline in prices, in the face of the strong statistical position of oil as a commodity. Stocks of refined in Europe are light, and, unless replenished, they will be exhausted within 90 days. This encourages exporters to expect a better demand than usual this spring. Exports during the past year to the Orient have been large, the shipments to Bombay have increased 50 per cent and to Calcutta 20 per cent, and these cities are on the outskirts of a population of 300,000,000 people. There are some fears that Germany may legislate in favor of Russian oil, and thus diminish the demand for the American article in that quarter. The highest price of crude for 1884 was $1.15⅝, the lowest 50⅞c. and average 84½c. The price now is 12c. below last year's average, and is 40 cents below the price one year ago. During the year 1881, there was an increase in stocks of 7,764,243 barrels; in 1882, 8,694,890 barrels; in 1883, 1,780,000 barrels; whereas in 1884 there was a reduction of about 300,000 barrels in stocks. The producers who have been bound during the past six months not to increase developments and production in the old districts had a meeting Tuesday at Bradford, and resolved that, "as the present price of oil is too low to encourage drilling, the shut-down movement be abandoned." As this movement did not apply to Thorn Creek, or any "wild-catting" or prospecting on new territory, it really should not be a bear argument. Consumption of oil about equals production now, and the only prospect for an immediate increase of production is to the southeast of the Thorn Creek pool, and in the vicinity of the McBride. A number of wells there will be due in about three or four weeks that may unsettle prices. The market for the past week has caused a number of heavy traders to sell their oil; and when this is absorbed by inside parties, it will be reasonable to expect better prices.

The following table gives the quotations and sales at the New York Mining Stock and National Petroleum Exchange :

		Opening.	Highest.	Lowest.	Closing.	Sales.
Jan.	3	$0.75½	$0.75½	$0.74⅛	$0.74⅜	2,363,000
	5	.74	.74⅛	.73	.73⅛	3,408,000
	6	.74⅛	.74⅜	.74¼	.74⅜	2,814,000
	7	.73	.73⅝	.72¼	.72¾	4,316,000
	8	.73	.73⅝	.72⅝	.73	2,619,000
	9	.73	.73	.71⅝	.72⅛	3,805,000
Total sales						19,311,000

Boston Copper and Silver Stocks.

[From our Special Correspondent.]

BOSTON, Jan. 8.

The past week has been about the dullest week in copper stocks for many years. The aggregated sales fall short of one hundred shares; in fact, there has been no market worthy of the name, and the few odd lots of stock sold furnish no real criterion of the con-

dition of the market. There is no pressure to sell stocks, fortunately, else prices would materially decline, but holders are disposed to wait for better times and keep their stocks until they can realize fair prices for them. Calumet & Hecla sold ex dividend at $135, a decline of $7 a share from last week's prices. Subsequently it rallied to $137, and one share sold to-day at $137½, closing offered at $137½, no bid. Sales, about 50 shares all told. Quincy is steady at $27, at which price four shares were sold, the only sales for the week; but $27 is bid for it, and but little offered. The December product is the smallest since April last, being about 260 tons. The product for the year 1884 shows an increase over 1883 of about 70 tons. Franklin is dull at $5¼ bid, $6¼ asked, with a sale of 20 shares at $5¼. The product of the Franklin for December was about 227 tons, the largest for any month in the year, except November, while the product for the year exceeds 1883 by about 200 tons. The Franklin can produce copper at a profit, even at the present price of ingot. It is out of debt, and ought to sell at much higher prices than at present. Osceola was $6 bid, $7 asked. The last sale, December 24th, was at $8. The company passes the January dividend, as an act of conservatism. It has a good surplus and no debt, and can make a profit with copper at 11c. a pound. The product for the year 1884 was 2507½ tons, against 2405½ tons in 1883. The reports from the Huron Mining Company continue of an encouraging character. The product for 1884 was 1143 tons, compared with 435 tons in 1883. There is nothing doing in the stock.

In silver stocks, the market continues to rule dull and inactive. At the Mining Exchange, there are only two or three active stocks, and even these are duller than ever this week. Bowman Silver is moderately dealt in at prices ranging from 12@15c. Dunkin, 18@20c. Catalpa, 23@26c. Consolidated Pacific is dull at $1. The anticipated boom in this stock does not seem to be in a hury to show up. The water meter stocks are in fair demand: New England, at 35@40c., and Standard at 65@70c. American Electric and Illuminating Company has taken on another of its periodical starts, and has advanced on free buying orders from 85c.@$1.90, the latter being for it this afternoon.

3 P.M.—At the afternoon Board, Calumet & Hecla sold down to $136½, and a small lot of Osceola at $7. Quincy was firmer at $27½ bid, $30 asked. Franklin, $5¼ bid, $6 asked. Atlantic, $5½ bid.

SAN FRANCISCO MINING STOCK QUOTATIONS.

Daily Range of Prices for the Week.

NAME OF COMPANY.	CLOSING QUOTATIONS. Jan. 2.	Jan. 3.	Jan. 5.	Jan. 6.	Jan. 7.	Jan. 8.
Albion	... ..	..	... ..	.. ..	.... ..	....
Alpha	... ..	... ..	... ..	... ..	.... ..	....
Alta	.10	.05	.30	.30	.30	.25
Argenta	... ..	... ..	.....	... ..	.... ..	....
Bechtel	... ..	... ..	... ..	... ..	.... ..	....
Belcher	.70	.60	.. ..	.52	.65	.65
Belle Isle	... ..	... ..	... ..	... ..	.... ..	....
Best & Belcher	1.12½	1.12½	1.25	1.12½	1.12½	.....
Bodie	2.12½	2.12½	2.12½	2.00	2.00	2.00
Bullion	... ..	... ..	... ..	... ..	... ..	... ..
Bulwer	... ..	... ..	... ..	... ..	.... ..	....
Challar	1.75	1.87½	2.12½	1.75	1.75	1.75
Con. Pacific	1.12½	1.12½	1.12½	1.12½	.....	1.12½
Con. Cal & Va	.35	.30	.35	.25	.30	.25
Crown Point	.95	.90	.80	.80	.80	.85
Day	... ..	... ..	... ..	... ..	.... ..	....
Elko Cons	... ..	... ..	... ..	... ..	.... ..	....
Eureka Cons	1.12½	1.25	... .	.. ....	1.50	1.50
Exchequer	... ..	... ..	... ..	... ..	.... ..	....
Gould & Curry	1.00	1.00	1.12½	1.00	1.00	1.00
Grand Prize	... ..	... ..	... ..	... ..	.... ..	....
Hale & Norcross	3.25	3.50	3.62½	3.50	3.62½	4.12½
Independence	... ..	... ..	... ..	... ..	.... ..	... ..
Martin White	.35	... ..	... ..	.35	... ..	....
Mexican	.60	.50	.55	.55	.55	.55
Mono	... ..	... ..	... ..	... ..	.... ..	....
Mount Diablo	3.75	3 75	....	....	....	....
Navajo	2.00	2.00	2.00	2.00	2.00	2.00
Northern Belle	... ..	... ..	... ..	... ..	.... ..	....
North Belle Isle	... ..	... ..	... ..	... ..	.... ..	....
Ophir	.55	.50	.50	.50	.55	.50
Overman	... ..	... ..	... ..	... ..	.... ..	....
Potosi	.65	.65	.75	.70	.70	.....
Savage	1.50	1.62½	1.62½	1.62½	1.62½	1.75
Scorpion	... ..	... ..	... ..	... ..	.... ..	....
Sierra Nevada	.65	.65	.70	.65	.60	.60
Silver King	... ..	... ..	... ..	... ..	.... ..	....
Tip-Top	... ..	... ..	... ..	... ..	.... ..	....
Union Cons	.50	... ..	.55	.50	.55	.50
Utah	... ..	... ..	.20	.15	.20	.....
Wales Cons	... ..	... ..	... ..	... ..	.... ..	....
Yellow Jacket	1.50	1.37½	1.37½	1.25	1.25	1.25
.....	... ..	... ..	... ..	... ..	.... ..	....

BULLION MARKET.

NEW YORK, Friday Evening, Jan. 9.

DATE.	London. Pence.	N. Y. Cents.	DATE.	London. Pence.	N. Y. Cents.
Jan. 3	49⅞	107⅞	Jan. 7	49 15-16	108⅛
5	49⅞	107⅞	8	50	108⅛@¼
6	49⅞	108	9	50	108¼

METALS.

NEW YORK, Friday Evening, Jan. 9.

Copper.—The market is a trifle firmer, and Lake has sold only in one small lot at 11c. at the Exchange. In the open market, 11⅛@11¼c. is the usual quotation, the Lake companies selling only to consumers at 11c. Other brands are higher. We quote 10⅝@10¾c. The lock-out at Butte has not come to an end, and the fact that the Parrot Company has not joined in the movement does not augur well for its success. In Arizona, the Old Dominion and United Verde mines are closed down, and the product of the Arizona Copper Company is expected to be smaller.

England cables £48 2s. 6d. for Chili Bars and £53 10s. for Best Selected.

The exports of ingot copper during the first eleven months were 24,224,246 pounds, and the exports of matte and ore 30,692 tons, thus showing that the total export in furnace products, ore, and ingot will probably not be less than 60,000,000 and possibly 70,000,000 pounds.

Tin.—We quote 16.25 for Straits cash, while England cables £74.

Lead.—During the week, about 1500 tons of lead have changed hands, the bulk of it Common lead, of which the representative of the largest producers in the country took 1000 tons, consumers following his lead as a buyer. The price started at 3·60c., went up successively to 3 62½c. and 3·65c., and to-day 100 tons have been taken at 3 75c., which we quote nominally. The ostensible reason for the advance is, that there is a prospect of a falling off in the make, due to small stock of smelters, and to the falling off in the make of the largest mine in Utah. We have every reason to believe that there is no immediate prospect of any scarcity of lead. The smelters will certainly not have empty charging-floors for at least a month or two to come. Then, indeed, if the blockade continues, the usual heavy falling in the output may be looked forward to.

Messrs. John Wahl & Co., of St. Louis, telegraph to us as follows to-day:

Our market is advancing on account of large purchases by speculators early in the week. Two hundred tons of Corroding lead sold at 3·40c. yesterday, and to-day sold again at 3·45c. The latter figure is now freely bid for Chemical and Refined, but holders are asking 3·50c

Messrs. John Wahl & Co., who, we may add, have removed to the Bank Building, southeast corner of Main and Market streets, St. Louis, send us the following short review of the lead market during the past year:

Prices of pig-lead have fallen off considerably during the past year, and it is safe to estimate that the average price for the year will be fully one half cent a pound lower than that of last year. Prices have swung within a very narrow range, and have fluctuated very little ever since the big break that occurred in the early spring, namely, when prices were forced down by some of our large speculators from 3·90c. to 3·40c. here. Consumers, during the entire season, purchased their supply in a hand-to-mouth way only, owing to the fact that they never at any time had sufficient confidence in the market to lay in supplies ahead of their current wants. Apparently every body has kept close to the wind. Stocks of lead, with the exception of the 10,000 tons held by the Richmond Company, which are practically out of market, are very light in all brands. Lead has been consumed about as fast as it has been produced during the past year, and the production of lead that had been predicted all along as falling short very materially, compared with that of 1883, will most likely equalize the same; and the general impression seems to prevail that it will show a slight increase. Consumption, regarding which the same predictions have been made from time to time, is about in the same shape, and will also show an increase over that of last year. The lead-pipe and sheet-lead men speak of the trade during the past year as very favorable. Sales, they say, are largely in excess of last year's. Prices have been low and profits small; but on an average, the result has been a quite satisfactory one. Corroders speak of their experience in a similar manner. In saying that the production of lead this year will probably exceed that of last, we must, however, add that the product of lead has fallen off very much during the past month, and is very likely to continue doing so during the next two or three months to come, from the fact that several large smelters have been compelled to cut down their product on account of low prices, and partly through the difficulty of securing ores, caused by severe cold and snowy weather in the mountains. Then there is another factor to be found in the present coke famine among Colorado smelters. Their men have all gone on a strike, and the smelters have been compelled to get their coke from the East at an additional cost of from $3 to $3.50 a ton. We regard, therefore, the entering of the New Year as a very favorable one, inasmuch as consumers are only supplied from hand to mouth, as no large stocks of lead are held by sellers, and there are no large stocks of bullion or ores held in the far West. We think it is safe to predict a more active and healthy market after the holidays; and also, it is safe to suppose from the before-mentioned facts, that prices are likely to rule considerably higher. The country at large is considered in a most excellent financial condition, and we predict a very healthy trade all around for the ensuing year.

Messrs. Everett & Post send us the following dispatch from Chicago:

The market is very steady at some advances on last week's quotation, with a good demand. Prices are nominally 3 45c. Offerings are only moderate. We note sales early in the week of 200 tons at 3·40c.

Spelter.—The market is unchanged.

IRON MARKET REVIEW.

NEW YORK, Friday Evening, Jan. 9.

American Pig.—The market is a slight shade better than it has been, due principally to a firmer feeling of sellers, who are in receipt of a larger number of small orders. Buyers, however, are still extremely conservative, and bids for large lots are very scarce.

We quote $18@$18.50 for No. 1 Foundry; $17@$17.50 for No. 2; and $16@$17 for Gray Forge, standard brands, tide-water delivery. Bessemer pig is very quiet, with Foreign nominally quoted $19. There has been a small business in Spiegeleisen, which we quote $30 for 30 per cent, $26 for 20 per cent, and $22 for 10 to 12 per cent.

Scotch Pig.—Arrivals continue very light. We quote ex ship and to arrive: Coltness, $21.50; Langloan, $21.50; Gartsherrie, $21; Summerlee, $20.50@$20.75; Eglinton, $19@$19.25; and Glengarnock, $20.

At the Metal Exchange, the following cables were received December 31st: Coltness, 56s.; Langloan, 56s.; Summerlee, 52s. 6d.; Gartsherrie 52s.; Glengarnock, 49s.; Dalmellington, 48s. 6d.; and Eglinton, 43s. 3d. Warrants were cabled 42s. 5d. to-day.

Steel Rails.—Only inquiries for small lots are occasionally received, for which $28 at mill is usually demanded.

Old Rails.—The market has been very quiet, with quotations nominally unchanged at $16.50@$17.

Philadelphia. Jan. 9.

[From our Special Correspondent.]

The expected business in pig-iron has not shown itself, except by way of inquiry for large and small lots, based on offers ranging from 25 to 50 cents a ton below inside asking prices. Some 10,000 or 12,000 tons of foundry and forge will be contracted for before Saturday. The average quotations are $18, $17, and $16 for Nos. 1, 2, and Forge. Some few lots of special brands went yesterday at high prices, but these figures indicate nothing. Two or three companies have been making active efforts to gather in contracts that will justify blowing in, and have received a few orders, but buyers are taking advantage of makers' anxiety, and are crowding down prices by very low offers. The situation in a nutshell is, that the expected activity has not arrived; that furnace companies are wait-

NEW YORK MINING STOCKS.

DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	HIGHEST AND LOWEST PRICES PER SHARE AT WHICH SALES WERE MADE.												SALES.
	Jan. 3.		Jan. 5.		Jan. 6.		Jan. 7.		Jan. 8.		Jan. 9.		
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
Alice, Mon.					2.10				2 10		1.95		300
Amie Con., Co.	.04								.03		.03		5,000
Argenta													
Bassick, Co.	3.00	2.50											300
Belle Isle, Ne.									.18				400
Bodie Cons., Ca.	2.15		2 25		2 20				2 25				800
Breece, Co.													
Bulwer, Ca.	.30		.30		.30								1,300
California, Ne.													
Cal. & Hecla, Mich.													
Castle Creek													
Chollar													
Carysolite, Co.							.90	.85	.85	.83			1,100
Cons. Cal. & Va.	.36	.35	.34		.35								2,600
Cons. Va., Ne.													
Dunkin, Co.													
Eureka Cons., Ne.			1.20		1.25				1.40		1.35	1.30	600
Father de Smet, Dk.			4 50										100
Findley, Ga.													
Gold Stripe, Ca.													
Gould & Curry, Ne.													
Grand Prize, Ne.													600
Green Mountain, Ca.													
Hale & Norcross, Ne.	4.00				4.65								250
Hall-Anderson, N. S.													
Homestake, Dk.											10.00		25
Horn-Silver, Ut.	3.00	2 75	2.85	2.65	2 90	2.80	2.85	2.75	2.80	2 75	2.75	2 70	7,505
Independence, Ne.													
Iron Silver, Co.													
Leadville C., Co.													
Little Chief, Co.			.24		.25						.25		500
Little Pittsburg, Co.											.25		100
Martin White, Ne.													
Moulton					1.15								300
Navajo, Ne.	1 85				1 90						1 90		1,100
Northern Belle													
North Belle Isle, Ne.													
Ontario, Ut.													
Ophir													
Plymouth	16.38	16.25	16.50	16 25	16.63	16.25	16.13	15.88	16.00	15.75	15.50	15.25	1,790
Quicksilver Pref., Ca.													
" Com., Ca.													
Robinson Cons., Co.	.35												200
Savage, Ne.													
Sierra Nevada, Ne.	.75				.72				.75				900
Silver King, Ar.	5.00	4 75	5 25				5.00	4 95					710
Spring Valley, Ca.													
Standard, Ca.	.59	54	.60		.69	.58	.50		.48		.44		2,420
Stormont, Ut.													
Tip Top, Ar.													
Yellow Jacket													

NON-DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	HIGHEST AND LOWEST PRICES PER SHARE AT WHICH SALES WERE MADE.												SALES.
	Jan. 3.		J 5.		Jan. 6.		Jan. 7.		Jan. 8.		Jan. 9.		
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
Albion	.12		.13	.12			.15						3,200
American Flag.													
Barcelona, G.											.10		200
Bechtel Con., G.													
Belvidere													
Best & Belcher, G. S.													
Big Pittsburg, S. L.													
Bradshaw, S.													
Bull-Domingo, S. L.													
Cal., B. H., G.			1.10								1.10		200
Central Ariz'na, S.									.15				300
Climax, Co.													
Colorado Central.	.75	.72											360
Cons. Imperial.													
Con. Pacific	1.00		1.00		1.00		1.00		.95				850
Decatur													
Durango, G.													
Eastern Oregon													
Goodshaw, G.													
Harlem M. & M. Co.													
Hortense, S.													
Lacrosse, G.													
Mariposa Pref., G.													
" Com., G.													
Mexican, G. S.													
Mono													
North Standard, G.													
N. Horn-Silv'r, S. L.													
Pri'n't'l & Miller, S.													
Rappahannock, G.												.04	1,000
Red Elephant, S.													
Ruby, of Arizona													
Silver Cliff, S.													
Sonora Con.													
South Bodie, G.													
South Bulwer, G.													
South Hite													
South Pacific													
State Line, I. & 4, S.													
" Nos. 2 & 3, S.													
Sutro Tunnel	.11				.11	.10			.10		.11		3,000
Taylor Plumas													
Unadilla, S.													
Union Cons., G. S.													

Tables giving dividends and assessments will be printed the first week of each month. Dividend shares sold, 28,300. Non-dividend shares sold, 9050.

ing for lower-priced coal; that there is little increased consumption, particularly in foundry; and that the expected activity is looked for in a week or two later.

Foreign Iron.—Bessemer is nominally $20@$20.50. There is no cheaper iron in the market now. One lot of spiegel is in negotiation.

Merchant Iron.—The sluggishness continues, and there is not a word to say, one way or the other. Prices and demand are as they have been all along, and from to-day's expressions, no immediate improvement is in sight.

Nails.—In a small way, nails are a little firmer, or at least makers are not making any effort to sell. Small store lots run at $2 10. No large sales are known. Quotations are nominally $2 for car-load lots.

Plate and Tank.—Business is quiet, with Plate at $2.10 for small lots, which is the only way it is going.

Structural Iron.—Angles are $2@$2.10. One or two brokers, negotiating for some bridge iron, expect to announce sales for Western delivery, but competition is very close, and it is hard to say which mill will get it.

Steel Rails.—In view of the uncertainty of the rate of wages this year, no large contracts have been placed. Nothing has been given out so far this week; but it is rumored that notices will be posted, Saturday, in one or two mills, announcing a reduction.

Old Rails.—A few one hundred ton lots have sold at $18@$18.50.

Scrap.—Scrap-iron of all kinds continues extremely sluggish, owing to the dullness in the bloomaries and mills, and the continued accumulation of stocks.

COAL TRADE REVIEW.

NEW YORK, Friday Evening, Jan. 9.

Anthracite.

Considerable talk is indulged in concerning the attitude of the Pennsylvania Railroad Company, and the efforts said to be making to induce it to join in the allotment plan. It is said that the other companies are willing to make concessions, etc. It might as well be generally understood at once that the Pennsylvania Railroad Company has always found its independent action profitable to itself, and that it is difficult to understand what inducements could be offered to make it depart from a fixed policy. The other companies will find, and we believe that they probably never expected any thing else, that they will have to make any arrangements concerning a reduction of output irrespective of what the Pennsylvania Railroad will do. The great interests at stake will simply force the dividend-paying companies to consent to any thing to keep the market from being flooded. We expect the new plan to hold together, at least till spring. How well it will stand the strain then of cheaper mining and wider markets, remains to be seen.

The market is in a very unsatisfactory condition, and coal can only be moved by concessions. We understand that some of the companies are harboring the absurd thought of advancing prices. They had better make some effort to get the prices that they claim to put forward. What little business there is, is apparently taken by individual operators, who are selling as low as $3.65@$3.70 for Stove, $2.85@$3 for Broken, $3 for Chestnut, and $2 for Pea. The companies ask, net, $3.90@$4 for Stove, and the others in proportion. The market will, evidently, not stand any bulldozing now, with the $3.04 Elevated Railroad contract still in the minds of consumers.

Bituminous.

The annual wrangle for contracts has not yet begun. Meanwhile, the long-continued negotiations between the Pennsylvania and Baltimore & Ohio railroads are said to have led to an agreement to go into force on March 1st, by which the tonnage is apportioned as follows: 55 per cent to the Pennsylvania and 45 per cent to the Baltimore & Ohio Railroad.

Philadelphia. Jan. 9.

[From our Special Correspondent.]

Stocks of coal at Port Richmond to-day are 155,000 tons. Business in the various offices has been very light this week, for reasons that need not be enumerated. Trade is in good shape, and some large transactions will be closed in a short time. The fact that on next Monday the annual meeting of the Reading Company will be held, is the occasion for a good deal of trade gossip. The following directors will be unanimously elected: Messrs. Keim, Wharton, Williamson, Comly, Lippincott, Wanamaker, and Sayres. Mr. Lippincott is the oldest member of the board, in point of service. Mr. Isaiah V. Williamson is the next oldest member, and has been connected with railroad affairs for many years. He and Mr. Lippincott control $2,000,000 worth of securities. Franklin A. Comly has been president of the North Penn Road for a number of years, and a Reading director for two years. Joseph Wharton is a prominent stockholder and manufacturer. Mr. Wanamaker is the well-known retail merchant. Mr. Sayre is a splendid engineer and railroad man, and, strictly speaking, the only practical man in the whole board. The others are excellent gentlemen in their way; but the criticism is frequently heard on the street, and in offices, that the entanglements in which the Reading Company is involved call for men with not only youth and its vigor and energy, but with the time to grapple with the difficulties that are now more serious than ever before in the history of the company. A number of collieries in the Lehigh region are idle. The new arrangements entered into with reference to the production are quietly arranging; but there seems to be something under cover in coal trade circles, concerning which those best informed are willing to say the least. There seems to be more or less uncertainty as to the permanency of the arrangement made, but no admission of the possibility of weakness can be had in any quarter. On the contrary, the statement is made that the details of the combination are satisfactory to all concerned, and that the business of coal mining and shipping will go along as quietly and satisfactorily as ever. Some very large contracts are likely to be placed in a few days, but at very low prices. Figures can not be obtained. Several inquiries are in hand to-day, and for considerable stocks, but there seems to be no urgency as to early deliveries. Reading coal shipments last week were 189,797 tons, against 129,401 tons in 1884, same week. To date this year, the shipments have been 1,029,364 tons, against 895,714 tons for the same time last year. There is a good deal of uncertainty as to the relations that will exist between anthracite and bituminous coal during the current year. Two or three factors recently introduced have unsettled trade prospects. The Beech Creek Railroad has reached Philipsburg, and is waiting there, on account of some litigation with the Pennsylvania with reference to crossing that company's lines. The operators in that section are not

satisfied with the proposition made with reference to shipping coal. They are offered 60 cents a ton for all the coal in their mines, and thus far it seems that only one or two of the operators have accepted the terms. At this rate, the mining of coal is said to be attended with a loss of about 12 cents a ton. The Clearfield operators are less hopeful of advantages than they were a few months ago, when the building of that road led them to think that competition would be unreserved. The railroad company is disposed to grasp every advantage within its reach. Another new factor in the coal problem is the fact of the development of the New River Division of the Norfolk & Western, which promises to throw the coal of that region into Eastern markets at very low prices, even though it is much farther by rail and water from the markets than is Pennsylvania coal. The uncertainty as to the extent of this new competition has a very unsettling effect. Virginia miners have offered bituminous coal at $3.50 in Boston. Clearfield coal has sold at New York at $2.75 and $2.87. At these prices, a good many operators see no room for doing any thing. Many are running half-time, and expect to do less before they do more. A great deal of new territory has been opened up. The Vanderbilt people intend to build several spurs into the mining regions. The production of the Clearfield region for two days of the past week was 15,704 tons, as against 33,148 tons for four days of the corresponding week last year. The bituminous people are hopeful of crowding their coal in, as against the pea and buckwheat coals of the anthracite region, but there is great uncertainty as to the extent of the competition between them. The total shipments of bituminous coal from the Clearfield region over the Tyrone Division of the Pennsylvania road for the year ended December 31st, 1884, were 3,173,363 tons, an increase of 307,189 tons over the production of the previous year. An agreement has been made by which fifty-five per cent of the bituminous traffic goes to the Pennsylvania Railroad and forty-five per cent to the Baltimore & Ohio Railroad.

Boston, Jan. 8.

[From our Special Correspondent.]

The old year having gone, and the receipts of domestic coal at this port having been collected, an opportunity is afforded of seeing how much coal has been consumed in this part of the country during 1884. The result will be something of a surprise to many. During the month of December, the receipts were only 129,978 tons, and one week of that month only about 7000 tons were received. The receipts for the year, however, were 2,184,064 tons, against 2,220,090 tons in 1883, showing a falling off of only 36,026 tons from the record of that banner year. This shows a good average for the year. The detailed receipts are here given in tabular form :

	For December.		For the Year.	
	1884	1883.	1884.	1883.
Philadelphia	56,047	76,909	964,491	968,347
New York	44,771	52,311	610,802	754,295
Baltimore	24,875	27,599	513,916	300,321
Richmond, etc	4,285	12,492	94,855	197,127
Total	129,978	169,311	2,184,064	2,220,090

The above table shows some interesting points, notably in the heavy gain in Baltimore business. Philadelphia holds its own in the matter of Eastern shipment, while New York has fallen off about 150,000 tons. Richmond and all other domestic ports show a falling off of about 100,000 tons.

The total imports, which have been culm coal from the provinces, have amounted to 27,772 tons at this port, against 51,181 tons in 1883, thus showing a decrease of about 50 per cent. About one half of the culm coal used in New England goes directly to out-ports, however ; to Lynn, Salem, Newburyport ; and this amount is not included in the Boston receipts of either year.

Another surprise in the way of statistics is the fact that the production of anthracite coal only fell off 1,000,000 tons, and that bituminous production increased 650,000 tons during 1884. Dull times to the contrary, the coal consumption appears to have been about as large as in 1883, unless it is held that there is an unusually heavy stock carried by dealers and unused by consumers, and that its effect will be felt in 1885. This theory does not seem a probable explanation.

It is easy to forecast a very unprofitable year to producers, unless there is an honest effort and desire for harmony. Although it is too early to predict a market, all signs point to lower figures. It looks now as if there would be a scaling of ten per cent throughout the market. The announcement is made that the allotment plan has been agreed upon by the anthracite companies ; but the Pittston price-list to contractors does not have the right kind of a look to it, namely, Broken and Egg, $3.10 ; Nut, $3.35 ; Stove, $3.70 f. o. b. at New York. Cargo prices are presumably 5 to 10 cents above these figures. It is the policy of the Pennsylvania people to reduce prices in mid-winter, and it is also a fact that their coal does not come to New England in large quantities. Still, such a reduction must have a material influence for lower figures. Rumors of large reduction by the other companies were afloat, but they appear to have been sensational. Prices remain wholly nominal at unchanged figures, and are likely to until matters become settled. Consequently, no one feels like buying, and the movement is small. We quote f. o. b. prices nominally as follows :

At New York, Stove, $3.80@$4 ; Egg, $3.25@$3.55 ; Broken, $3.20@$3.40 ; Pea, $2.25 ; Nut, $3.45@$3.60. At Philadelphia, $3.90@$4 for Stove ; $3.25@$3.50 for Egg ; $2 for Pea ; $3@$3.15 for Broken. Special coals, $4.75@$5 for Broken, $5.35@$5.50 for Stove.

There is yet no bituminous trade to report. Nothing definite seems to result from all the drumming of trade that is going on. The prospects are, that business will start somewhere between $3.25 and $3.50, but unless the railroads take an additional reef in freights, such business must be unprofitable to producers. And such reduction by the railroads is not probable. Nevertheless, an offer of $3.50 delivered would undoubtedly be accepted by the coal companies. Water freight can not go lower in the year to come—all agree to that. Many think an advance will come about next fall. But in any event, a year's contract taken now involves a risk of from fourteen to fifteen months' freights, and when $3.50 is named on such a contract, it is either recklessness or else the company has "an anchor to windward" of which the trade is ignorant. Tanners and a few others will continue to buy culm during the coming year, but the amount will be small. Bituminous dealers consider that the anthracite companies will get back some of their manufacturing demand this year, but it is surely a losing contest to the latter. In a few years, the bituminous men will have the steam trade.

We quote cargo lots bituminous at $3.55@$3.70 delivered.

There is a fairly firm freight report. Figures are unchanged. Barges still continue to come around from New York. We quote :

New York, 90c.@$1.15; Philadelphia, $1.20@$1.30; Baltimore, $1.20@$1.25 ; Newport News, $1.20 ; Richmond, $1.25 ; Cape Breton, $1.55@$1.60 ; Bay of Fundy, $1.30@$1.40.

There is little doing in a retail way, owing to mild weather. The unusual procedure of having one set of prices for all winter seems likely. We quote :

White ash, furnace and egg	$5.25@$5.50
" " stove and nut	5.50@ 5.75
Red ash, egg	6.00
" " stove	6.25
Lorberry, egg and stove	6.50@ 6.75
Franklin, egg and stove	7.50
Lehigh, furnace, egg, and stove	5.50@ 5.75
" nut	5.75

Wharf prices, $4.50 for Broken, $4.85 for Stove.

Buffalo, Jan. 8.

[From our Special Correspondent.]

The subject of coal freight rates at Buffalo will be discussed this week by representatives of the New York, Lake Erie & Western, Lake Shore & Michigan Southern, Rochester & Pittsburg, and Buffalo, New York & Philadelphia railroads, at a conference, to be held in New York City. Shippers have been invited to be present. It is rumored that the charges are to be raised, which was a matter of surprise to Buffalo parties at any rate.

The receipts of coal at this port by the Lake Shore & Michigan Southern Railroad for December last were 3170 tons ; 2130 tons for Buffalo, and 1040 tons for other points. For the year 1884, 41,717 tons ; 26,037 tons for Buffalo, and 15,680 tons to other points. The aggregate for 1884 shows a decrease of 27,916 tons under 1883, and 5218 tons under 1882.

Your readers, of course, are acquainted with the relative proportion of anthracite coal that each company is to mine during 1885. It is a question to be decided whether all of said companies will agree to the appointment. The trade here expects that low prices will prevail during the year, but say little or nothing of the action of the companies they represent. The old rates continue to be published in the newspapers, which is very misleading to the poor man, who as a rule knows nothing about the trade except when his necessities require a ton of coal for family use, and if he takes the advertisements as a guide, he simply "gets stuck."

The total tons of coal carried by the New York, Lake Erie & Western Railroad for the year ended September 30th, 1884, was 7,872,330 tons, as compared with 6,925,469 tons in 1883, and 6,104,672 tons in 1882. This includes both hard and soft coal received at all points.

STATISTICS OF COAL PRODUCTION.

Comparative statement of the production of anthracit coal for the week ended December 31st, and year from January 1st :

Tons of 2240 lbs.	1884.		1883.	
	Week.	Year.	Week.	Year.
Wyoming Region.				
D. & H. Canal Co.	97,946	3,986,377	.....	3,975,630
D. L. & W. RR. Co.	73,203	5,184,563	74,074	5,011,408
Penna. Coal Co.	7,104	1,304,974	20,273	1,481,682
L. V. RR. Co.	26,131	1,402,003	17,386	1,399,669
P. & N. Y. RR. Co.	4,961	225,110	1,733	214,492
C. RR. of N. J.	*	*	*	1,202,078
Penn. Canal Co.	.....	430,708	.....	486,663
North & West Br. RR.	17,979	†844,922	9,723	527,842
	227,324	13,378,657	123,189	14,299,464
Lehigh Region.				
L. V. RR. Co.	77,623	4,685,628	58,844	4,973,259
C. RR. of N. J.	*	*	*	1,126,889
S. H. & W. B. RR.	.....	†140,522	1,670	47,641
	77,623	4,826,150	60,514	6,147,789
Schuylkill Region.				
P. & R. RR. Co.	176,951	11,329,468	133,139	9,771,043
Shamokin & Lykens Val.	*	*	*	950,363
	176,951	11,329,468	133,139	10,721,406
Sullivan Region.				
St Line & Sul. RR. Co.	3,642	79,585	1,350	68,495
Total	485,540	29,613,860	318,192	31,237,154
Increase	.....	.....	.....	.....
Decrease	.....	1,623,294	.....	.....

* Included in tonnage of the Philadelphia & Reading Railroad.

† Week ended December 27th.

The above table does not include the amount of coal consumed and sold at the mines, which is about six per cent of the whole production.

Total same time in 1879.....25,769,385 tons.
" " " " 1880.....23,096,111 "
" " " " 1881.....27,991,164 "
" " " " 1882.....29,316,387 "

The increase in shipments of Cumberland Coal over the Cumberland Branch and Cumberland & Pennsylvania railoads amounts to 229,327 tons, as compared with the corresponding period of 1883.

Comparative Statement of the Production of Bituminous Coal for the week ended December 27th, and year from January 1st :

Tons of 2000 pounds, unless otherwise designated.

	1884.		1883.	
	Week.	Year.	Week.†	Year.
Cumberland Region, Md.				
Tons of 2240 lbs.	46,590	*2,848,892	.....	2,412,686
Barclay Region, Pa.				
Barclay RR., tons of 2240 lbs.	2,254	*285,781	7,006	327,916
Broad Top Region, Pa.				
Huntington & Broad Top RR., of 2240 lbs	3,035	*192,707	.....	187,680
East Broad Top	.....	.....	936	42,708
Clearfield Region, Pa.				
Snow Shoe	2,533	181,831	3,446	256,950
Karthaus (Keating)	875	57,182	.....	.....
Tyrone & Clearfield	45,080	3,130,732	38,216	2,836,362
Alleghany Region, Pa.				
Gallitzin & Mountain	6,611	399,602	7,947	456,454
Pittsburg Region, Pa.				
West Penn RR.	4,805	283,932	4,441	387,750
SouthwestPenn. RR.	1,287	122,453	1,705	123,430
Pennsylvania RR.	4,543	267,673	6,196	601,872
Westmoreland Region, Pa.				
Pennsylvania RR.	20,543	1,314,419	21,136	1,388,957
Monongahela Region, Pa.				
Pennsylvania RR.	2,489	158,077	.....	.....
Total	140,645	9,243,281	90,129	9,022,765
Increase	.....	220,516	.....	.....

* Total for 1884.